THE POPULATION ECOLOGY OF THE NIGERIAN OLIVE BABOON AND ITS RELEVANCE TO MANAGEMENT

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In fulfilment of the
requirements for the degree of

Master of Philosophy (M.Phil.)

University of Edinburgh
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1978

To my Parents, to Bola, Leke, Kamal, Yemo and

Makanjuola - For their love.

A C K N O W L E D G E M E N T S

Acknowledgement to Individuals

Any success which this project may lay claim to has been due to significant contribution by many people.

Outstanding in this respect is Dr. Jim Lockie, my one-time supervisor. I am most grateful to him for his inestimable help and friendliness. Dr. Jim Lockie was instrumental in planning this project. In addition he carefully read the entire manuscript and did much to clarify the presentation by guiding me to think and write more logically and concisely. He, Jim, made me happy doing my work and inspired me in the process. I am extremely fortunate to have been supervised by him.

Professor P.G. Jarvis, head of the University's Department of Forestry and my current supervisor, made it possible for me to undertake the field work in Nigeria. He offered me useful logistic advice and his encouragement inspired me in the field where I tried in my own small way, to imitate his industrious approach to work. Professor Jarvis has consistently shown extraordinary interest in this work and its progress. I hereby express my deep appreciation to him and to Professor C.J. Taylor whose understanding and encouragement I found indispensable. Drs. I. Langdale-Brown, W.E.S. Mutch and R.I. Muetzelfeldt, all of the Darwin Building, were ever ready to come to my aid. I wish to register my thanks to them.

I am indebted to Dr. John Deag and research student Tony Collins, both of the University's Department of Zoology. Not only did they make their personal libraries open to me at all times but they also offered me ideas and suggestions that have been of immense value in this project. I owe the frontispiece plate to Tony's generosity.

The co-operation and enthusiasm of my field assistants - Lateef, Adesola and Samson - did much to enhance the quality and quantity of the field work. I sincerely thank them. Drs. Ogunwale, Afolayan and Chachu, Messrs Ayeni, Soladoye, Asafa, Falobi, Saba and R.M. Ajao, all helped in various ways in the course of the field work: they have my thanks.

Tunji, my brother, Mr. James Whitehead and Miss Mapula Dlamini, my friends, came to my aid at the final stage of preparation of this thesis. They should please accept my gratitude for making my work lighter at the expense of their own studies.

Although guided, inspired, encouraged and helped by all the aforementioned persons - God bless them all! - I am, of course, solely responsible for the results and for any errors of commission or omission that may be detected either in methodology or in presentation.

Special Acknowledgement to the Government of Nigeria

My study and stay in Edinburgh University and this research were generously financed by the Federal Government of Nigeria through its Federal Department of Forestry, my immediate employers. I deeply appreciate the opportunity given me and solemnly pledge to Nigeria my loyalty and service 'with all my strength'.

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ABSTRACT

This is the report of a study of the population ecology of the Nigerian savanna olive baboon, Papio anubis Fischer, which was undertaken in the Kainji Lake National Park, KLNP, of Nigeria. The study area, covering 3,924 sq. km. (1,533 sq. mls.), was for this purpose stratified into five major vegetational components.

The project aimed at providing information on the population and related ecology of the olive baboon and at applying such information to the management, including control, of the monkey within and around the Park.

The baboon troop size in the Park varied from 18 to 43, with an overall weighted troop mean size of 33 animals. Permanent water, where available, was found to be associated with a significantly larger troop size than elsewhere. The total baboon population in the Park has been estimated to be about 5,734.

The animals ranged between 3.20 and 5.32 km. daily, depending directly on troop size. There was a high positive correlation between home-range extent and the size of the four troops of intense study.

The baboons were highly selective of their floral food items, were mainly frugivorous and spent 47 per cent of their day-time feeding. Most of their food items are also utilised by man and their feeding habits overlapped extensively with those of the elephants.

Proposals are made for managing the baboon populations in the KLNP. The lines suggested include the provision of additional water-holes in the dry period, the suppression of poaching in the area and periodic culling of the baboon populations as their condition in relation to the habitat or their density may dictate.

Factors that may possibly affect crop-raiding by baboons are discussed and recommendations — principally on farm-land management coupled with effective human attendance on farms — are made for safe-guarding cultivated crops from the animals.

Plate 1
The Olive Baboon, Papio anubis, Fischer. Photograph shows an adult male.

"What is man without the beasts?
If all the beasts were gone, men would
die from great loneliness of spirit, for
whatever happens to the beasts also happens
to the man. All things are connected.
Whatever befalls the earth befalls the sons
of the earth."

Chief Seathl (Seattle), 1855.

CHAPTER 1

INTRODUCTION

CHAPTER 1

I N T R O D U C T I O N

1-1 SCOPE OF STUDY

1-1.1 Objectives

This report gives the results of and conclusions from a field study of the population structure, ecological dispersion, feeding habits and time-budget of the olive baboon, Papio anubis (Fischer) in Borgu Section of the Kainji Lake National Park, Nigeria.

The census was undertaken with the aim of producing quantitative information against which to evaluate future population dynamics of the baboon in the Kainji Lake National Park to be hereafter referred to as the KLNP. The other aspects of the study are observations on the ecology and behaviour of the population which supply data on the Nigerian baboon in time and space between April 1, and September 30, 1977.

The over-all objective of the project is to evolve management principles for P. anubis primarily in the KLNP. It also examines why the feeding ecology of the animal conflicts with human agricultural interests and offers simple suggestions for minimising if not eliminating the menace of crop depredation so commonly reported against baboons in virtually all their areas of distribution.

1-1.2 Why Baboons?

Although man and baboon have shared the African continent for over a million years (De Vore and Hall, 1965), there is a lack of systematic data on ecology and behaviour of the animal in any West African area south of the Sahara (Hall, 1965a). The position has probably changed in some of the areas concerned, but it remains largely so in Nigeria where information on baboon and indeed other non-human primates is mainly anecdotal. This fact became apparent when the Wildlife Division of the Federal Department of Forestry Nigeria, early in 1976 needed information on Nigerian non-human native primates. The information was sadly lacking.

Howell's (1968/69) works on the animals of the Borgu Section of the KLNP give general information on the baboon, branding the animal as "farm robber par excellence". Child's (1974) report gives outline ecological information on the major mammals in the area and calls for an in-depth study of every major mammalian species there. It was largely in answer to this call and out of the desire of the Federal Department of Forestry, Nigeria to initiate the "filling of the gap in the knowledge of native non-human primates" (Saba, pers. comm 1977) that this study was undertaken.

It is requested in all humility that the works reported here should be classed as only a preliminary field investigation concentrated on a species not previously systematically studied

on its own merit in Nigeria. I hasten to inform the reader that this project is necessarily open-ended in data collection and interpretation. The very short though continuous period of six months spent in the field should not be expected to supply answers to all questions on the Nigerian olive baboon. In fact, the author was fortunate to have had three efficient field assistants who helped to enhance the quality and quantity of data collection. Otherwise many questions answered in this report would have remained largely unanswered.

If this project has succeeded in answering a few questions on the population ecology of the Nigerian olive baboon and relates this to the management and/or control of the animal, its aim will have been achieved.

1-2 LITERATURE PERSPECTIVE ON BABOONS

1-2.1 Taxonomic Considerations of Baboons in General

There are many baboon types in Africa and most of them are mainly ground-dwelling. It has been suggested (Hall, 1966 citing Jolly, 1964) that from historical usage the term "baboon" should not be confined to the Papio species but should include all the mainly terrestrial monkey species such as mandrills, drills and gelada. Hall's (1966) proposed generic classification applies the term to include the species of Papio, Mandrillus and Theropithecus, all of which he says have certain characteristics in common. According to De Vore and Hall (1965) it may be unnecessary to recognise more than one genus (Papio) of baboons.

The baboons included in the cynocephalus (yellow), ursinus (chacma), anubis (olive) and papio (western) species of the genus Papio are very closely related and judged by modern taxonomic criteria are best considered as mere racial or clinal forms of the same species (De Vore and Washburn, 1963; Crook, 1970; Rowell 1972). Only P. hamadryas (arid savanna baboon) deviates from the general morphology and social structure of the above-named four species of Papio (Crook, 1970; Kummer, 1971; Rowell, 1972). Marais (1939) states that the baboon species mix in Northern Transvaal, South Africa, and Kummer (1971) asserts that hybrids of olive and hamadryas baboons exist. According to Hall (1966) intermediate baboon forms occur between East and South Africa.

A.B.O. blood tests have produced physiological evidence of the closeness of most Papio baboons. Wiener and Moor-Jankowski (1969) have reported that from the tests they performed , none of the 60 yellow, 174 olive or 89 chacma baboons is in blood group O, while in western baboon numbering 188, only 1.1 per cent falls into that blood group.

1-2.2 The Nigerian Baboon: Taxonomy

The Nigerian baboon is a savanna monkey and is of the olive type. It is olive-brown and characteristically carries its 'tail broken' (Dorst and Dandelot, 1970) forming an inverted letter 'U' with a rather narrow base. The olive baboon is Papio anubis (Fischer) although it is occasionally designated as

P. doguera (e.g. De Vore and Hall, 1965). Crook and Aldrich-Blake (1968) have even referred to the olive baboon as Papio anubis doguera (P.a. doguera), thereby conforming to Roth's (1965) suggestion for a trinomial classification in which the third name designates the geographic range or outstanding anatomical characteristics of any given primate.

In the face of the apparent unresolved taxonomic confusion, this report will refer to the Nigerian olive baboon simply as Papio anubis.

The taxonomy of the Nigerian olive baboon which immediately follows has been culled from Rosevear's (1953) text:

Class	Mammalia	Linnaeus 1758
Order	Primates	Linnaeus 1758
Sub-order	Anthropoidea	Mivart 1864
Family	Cercopithecidae	Gray 1821
Genus	Papio	Erxleben 1777
Species	anubis	Fischer 1829

The races of P. anubis are not considered relevant for inclusion here, more so, that to come to conclusions on this aspect of baboon taxonomy is to introduce unnecessary taxonomic complications.

1-2.3 Outline of Biology and Ecology of Baboons

The African baboons are a social non-human primate whose species are mainly ground-dwelling because most of them inhabit

savannas. However, some baboon populations are forest animals (Rowell, 1966; Marais, 1969; Altmann, 1974), implying that they might be more arboreal than is generally reported.
Baboon troop size varies both regionally and locally.
Regionally, the size of Papio anubis varies from about 10 to 200 animals (De Vore, 1963). Local variation in troop mean size is illustrated by the observations of Henshaw and Ayeni (1971) in Yankari, Nigeria and those of Ayeni (1977a) in the KLNP. Both areas of observation are within the Northern Guinea Savanna Zone; yet the reported troop mean size in the former is 6.5 while it is 16.6 animals in the latter.

P. anubis is a generally large and heavily built monkey being up to 40 in. (10.16 cm.) long without its tail (Dorst and Dandelot, 1970). Its infant weighs about 500 grammes at birth, while the fully grown adult male and female weigh about 40 kg. and about 22 kg. respectively (Rowell, 1972). From his examination of patterns of their dental attrition, Bramblett (1969) has put the average life-span of Kenyan olive baboons at 18 years, with results that indicate that the male maxillary dentition may function for up to 20 years. The longevity record for captive baboons is around 44 years (Rowell, 1972). Baboon females reproduce biennially (Simonds, 1974).

Baboon has 42 chromosomes , (Hill, 1974)
and reference has earlier been made to the significant absence of blood group O members in the Papio species tested by Wiener and Moor-Jankowski (1969).

Baboon troops use trees or cliffs as sleeping sites, depending on availability. Papio species forage some two to six km. (Rowell, 1972) virtually every day during the day-time. The longest daily distance reported for any of them is about 19.32 km. (12 miles) for a group of chacma baboon in South Africa (Hall, 1962a). Home-ranges of baboon troops vary considerably and may overlap in adjacent troops (Stoltz and Saayman, 1970). Baboon troops use traditional paths within their home-range (Hall, 1960), and the "core area" is more extensively used than other parts of the home-range. Territorial defence is rare in baboons, perhaps the only systematic observation of it being reported by Hamilton et al (1976).

The large cats are their chief carnivorous predators and these they are often able to detect and evade by virtue of their keen eyesight (Marais, 1969), the efficiency of which they enhance by constantly using vantage points like termite mounds, rock outcrops and trees. This enables them to scan their surroundings through some distance for potential predators.

Literature reports show that baboons are notorious crop-raiders in their entire range of distribution. They cause havoc to property and cars inside Parks (Hall, 1960; Chipperfield, 1975) and are known to throw stones at observers (Hamilton et al 1975; Pickford, 1975). They have had a reputation of occasional ferocity towards man, particularly his

women and children (Clarke, 1969). They seem to adjust easily to captivity although the adult males make occasional charging advances at their observers in the Ibadan Menagerie: this behaviour was not observed by us even once in the wild.

Because of their natural adaptability, baboons prove most suitable for many medical and scientific workers who use non-human primates for experimental studies (Hall, 1966).

1-2.4 General Distribution Pattern of Papio anubis in Nigeria

The Nigerian olive baboon is a savanna non-human primate usually associated with rocky outcrops (Rosevear, 1953; Olaniyan, 1975). Rosevear's (1953) map shows that Papio anubis probably occurs in all Nigerian Savanna Zones except the fringe Sahel Savanna in the country. Its occurrence has not been reported in the Rain Forest Zone which contains a number of other monkey species. Figure 1, a map, is here relevant.

Personal observations suggest that P. anubis is most concentrated in the Guinea Savanna Zone within which the KLNP falls. This is probably because this Zone covers about 40 per cent of the total area of Nigeria (Hopkins, 1965) and is the richest savanna type in Nigeria (Oboli and Church Harrison, 1965).

CHAPTER 2

THE ENVIRONMENT AND BASIC METHODOLOGY OF STUDY

CHAPTER 2

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2-1 THE ENVIRONMENT

2-1.1 Vegetational Outlook of Nigeria

Nigeria is a tropical African country. Keay's (1959) Vegetation Map shows that the country contains a number of Rain Forest and Savanna Zones, as well as an ecotone of the two which is usually referred to as "derived savanna" (term used by Jones, 1954). The accompanying Map, figure 1, shows the geographical location of Nigeria and the pattern of distribution of the vegetation zones.

Nigeria is an aggregation of very diverse habitat types and Rosevear (1953) has observed that its various vegetation zones are faunistically often more closely related to distant countries than to one another. Since the Study Area lies within the Savanna Zone, discussions on vegetation will be restricted virtually to the savanna which in fact is the Zone in which the baboon occurs in Nigeria.

The term "savanna" is derived from the Spanish word "Sabana" meaning grassland (Clayton, 1958). Aware of the unsatisfactoriness of the term in describing the African vegetation (Bourliere and Hadley, 1970), the Range Classification

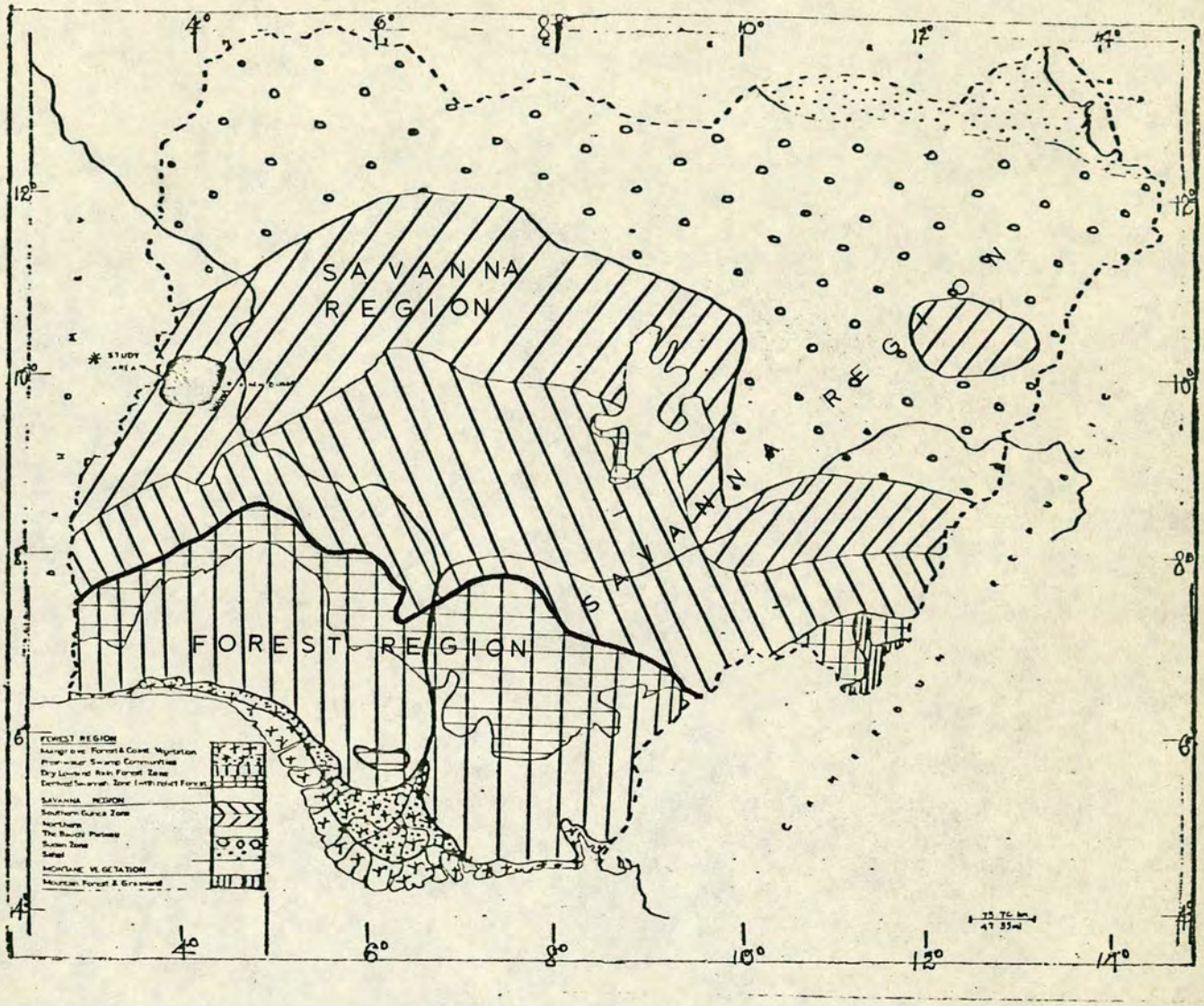


Figure 1. Nigeria: Map of Vegetation Zones (After Keay, 1959). The Country covers an area of 913,072.64 sq. km. (356,669 sq. mls.). Location of Study Area is indicated.

Committee of East Africa has on the basis of ecological and physiognomic considerations approved the replacement of the broad-based term "savanna" with precise ones like "grassland", "wooded grassland", "bushland" and "woodland" (Pratt et al 1966). However, since the term "savanna" is still widely used in West Africa and in literature, it seems reasonable to continue to apply it in this report.

Savanna is more widespread in Africa than in any other continent (Eyre, 1968; Moore, 1974) and is the bulk of Nigeria's vegetation. The Savanna types in Nigeria are Guinea, Sudan and the scanty Sahel. The Guinea Savanna Zone is the most extensive vegetation type in Nigeria where it occupies about 40 per cent of the area (Hopkins, 1965). It exhibits variations and is therefore divided into Southern and Northern Sub-zones (Keay, 1959). It is floristically the richest savanna zone in Nigeria (Oboli and Church Harrison, 1965). The study site of this project lies within this Zone.

2-1.2 THE STUDY AREA

2-1.2.1 Extent

Reference to earlier figure 1 shows that the KLNP lies within the Northern Guinea Savanna Zone. The Park (KLNP) is made up of the Study Area designated Borgu Section and the adjoining Zugurma Section. The former Section which used to be known as Borgu Game Reserve, covers 3,924 sq. km. (1,533 sq. miles) while the latter Section is 1,386 sq. km. (541.4 sq. miles) in extent (Ayeni, 1977a). The Borgu

Section is located between latitudes $9^{o}45'$ and $10^{o}23'$N and between longitudes $3^{o}40'$ and $4^{o}32'$E in the Ilorin Province of Kwara State of Nigeria.

2-1.3 BIOTIC ENVIRONMENTAL FACTORS

2-1.3.1 Vegetational Background Information

According to Charter (1970) the Study Area is a "mixed leguminous savanna woodland". Rattray (1960) designates the area as an "Andropogon zone" on the basis that the Andropogon grass, though not necessarily dominant there, is sufficiently abundant and conspicuous to warrant its use as a genus type in the area.

Pioneering vegetation analysis of the Study Area was undertaken by Howell (1968). The first comprehensive analysis and mapping of the area was done by Child (1974) who grouped the vegetation into seven components "having significance as wildlife habitats". The most detailed and up-to-date Vegetation Map (1 : 100,000) of the Park has been prepared by Geerling (1976) whose groupings closely follow on those of Child (1974) except that he has broken down the latter's first component group (Burkea/Detarium Wooded Savanna) into a number of sub-types and has added a new group, the Acacia Component.

2-1.3.2 Details of Vegetation Sub-types

Based principally on the works of Child (1974) and Geerling (1976), the accompanying account shows the major vegetational sub-types in the Study Area:

A. Burkea-Terminalia avicennioides Savanna Woodland

This is the most extensive vegetation sub-type within the area. This component is moderately tall and is usually found on fairly deep yellowish to reddish soils which are generally light-textured, but sometimes gravelly. It is associated with upper and middle slopes.

The two commonest species are Burkea africana and Terminalia avicennioides. The former is more conspicuous because it is taller than the other which is more numerous. Associated trees and shrubs include the rather common Butyrospermum paradoxum, Combretum glutinosum, Piliostigma thonningii, Crossopteryx febrifuga, Strychnos spp. Parinari polyandra and Pteleopsis suberosa.

The grasses are mostly the Andropogon and Hyparrhenia spp. all of which are generally tall, sometimes attaining a height of three metres (personal observation).

Visibility is good when the grasses are out of season, otherwise it can be poor (personal observation).

B. Acacia Component

This vegetation sub-type consists of Acacia variant and Acacia savanna woodland. The former is rather low and relatively dense, occurs on migmatites and forms a transition to the latter which is a less dense pure Acacia savanna woodland. The woodland variety is open and grows on shallow soils which are not so fertile.

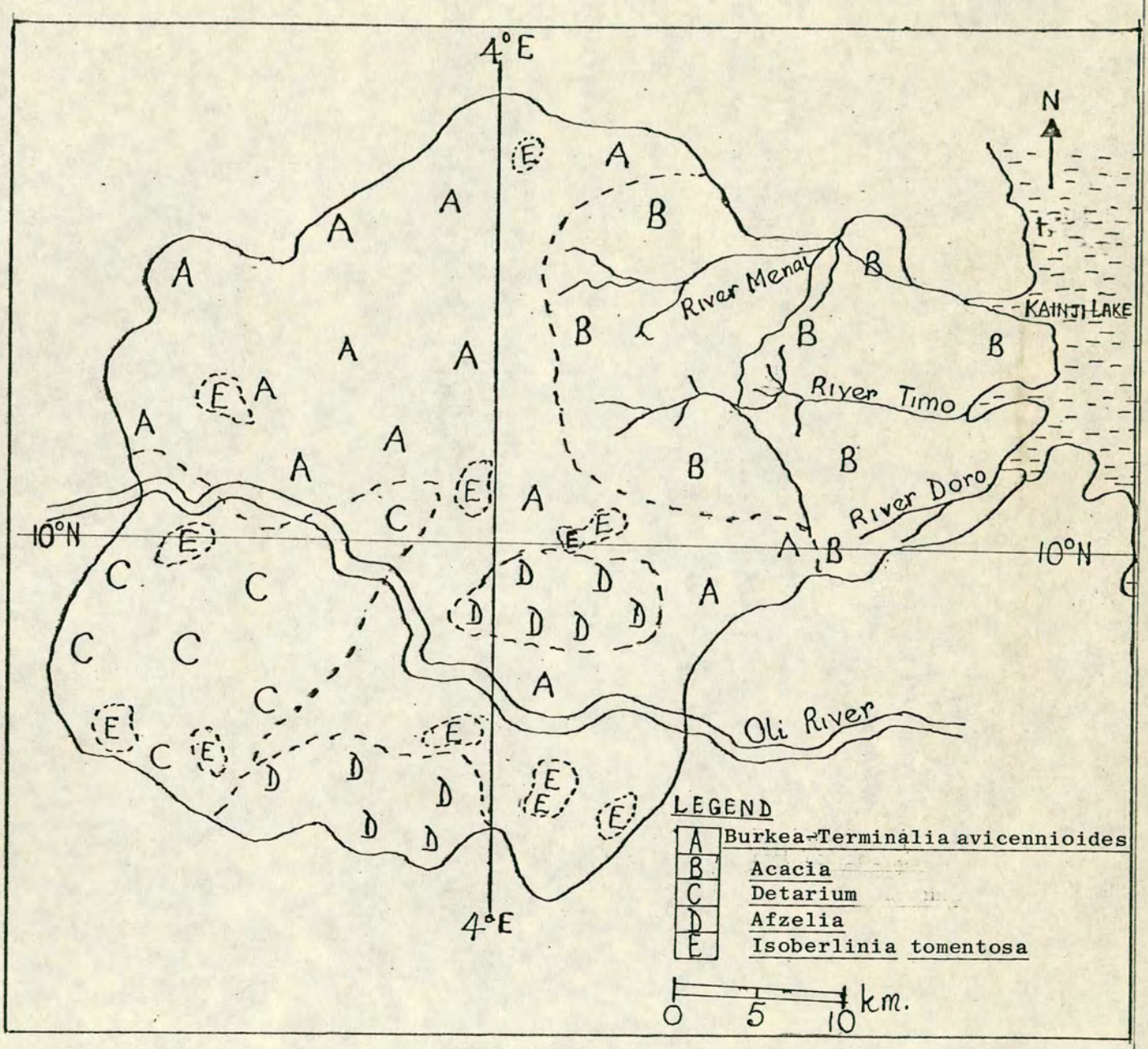


Figure 2. Simplified Map of Major Vegetation Sub-types in the Study Area, the Kainji Lake National Park, KLNP, of Nigeria. (After Child 1974 and Geerling 1976).

Plate 2. Primary Habitat Type A: Burkea-Terminalia avicennioides Savanna Woodland. The most extensive vegetation type in the KLNP of Nigeria. Visibility is fair.

Plate 3 One Component of Primary Habitat Type B: *Acacia* Variant. Visibility is poor.

The Acacia vegetation sub-type has a varying number of Acacia species, the commonest of which is A. hockii. Other trees and shrubs are those of the Burkea-Terminalia group in varying degrees except in the pure woodland section where Burkea africana and Terminalia avicennioides are virtually absent.

In this sub-type as in the case of the Burkea-Terminalia group, the grasses are mostly Andropogon and Hyparrhenia spp., with the addition of grasses of shallow soils, especially Loudetia spp.

Visibility is generally poor in this area which is second in extent to Burkea-Terminalia sub-type.

C. Detarium Savanna Woodland

This is a rather low and dense savanna woodland type in which Detarium microcarpum is dominant on shallow soils. The soils are generally light-textured, often gravelly dark and overlay an iron-stone hard pan.

Most other species of the Burkea-Terminalia group also occur here.

The important grass species include the usual Andropogon and Hyparrhenia spp. as well as Ctenium spp which are grasses of shallow soils. Personal observations indicate that here the first two grasses grow to their full height of about three metres. This factor contributes to its low visibility, particularly near water courses.

Plate 4. The Second Component of Habitat Type B: Acacia Savanna Woodland. This is much more extensive than the Acacia Variant Component. Both sub-types make up [illegible] B, Acacia Complex, where visibility is generally poor.

The abundance of rocks and pebbles in this woodland is perhaps not unconnected with its apparent low fertility.

D. *Afzelia* Savanna Woodland

This is open savanna woodland on generally fertile medium-textured soils which are yellowish or reddish.

Afzelia africana is dominant, other common trees being *Burkea africana*, *Detarium microcarpum*, *Terminalia avicennioides* and *Strychnos* spp. *Tamarindus indica* is scattered here and there, often in association with termitaria.

The grasses are mostly perennials and in addition to the common *Andropogon/Hyparrhenia* combination, this woodland contains *Hyperthelia dissolute*.

This habitat type has good visibility and is easily accessible. *Afzelia africana* trees are robust and the plant has a high canopy "which throws a light shade over the whole area ... and the whole (structure) is reminiscent of an English park" (Howell 1968a).

E. *Isoberlinia tomentosa* Woodland

This is a tall woodland with the closest canopy in the Study Area. It occurs on well-drained fairly-deep rather heavy

Plate 5. Primary Habitat Type C: Detarium Savanna Woodland. Visibility is poor but is better than in habitat type B.

red soils and in almost pure stands with distinct boundaries.

The dominant species is Isoberlinia tomentosa and most of the woody species of the Burkea-Terminalia group occur in this habitat in rather small numbers. Ostryoderris stuhlmannii is one of the more common secondary species while Tamarindus indica is fairly widely distributed as usual in association with termite mounds.

The grasses here are essentially shade-loving species such as Andropogon tectorum, A. gayanus together with Beckeropsis uniseta, and on poorer sites Hyparrhenia smithiana and Loudetia spp. Generally, the grasses under the canopy are not as tall as those in the open area of the KLNP.

Visibility in the study area is certainly best in this plantation-like woodland which easily catches the eyes of all visitors to the Park.

The other sub-types of vegetation mapped by Child (1974) and Geerling (1976) are considered mere variants of the ones listed above or otherwise almost negligible in extent that this study does not take them into account. Only the five major vegetational sub-types already discussed constitute the primary habitat types forming the ecological basis of this study. Water courses have

Plate 6. Habitat Type D: Afzelia Savanna Woodland. This primary habitat type has good visibility.

Plate 7. Habitat Type E: Isoberlinia tomentosa Woodland where visibility is at its best in the KLNP of Nigeria.

a common effect on all of them and this will be discussed in the next section.

2-1.3.3 Water Courses in Relation to the Vegetation

Although the Oli River is a source of permanent water supply to the vegetation in the Study Area, it has not been reported to flow during (the few) dry-season months immediately preceding the onset of rains. Wherever it passes through any of the five primary habitat types A to E already discussed, it casts characteristic riparian features on the vegetation making it look like a forest within the savanna woodland. Such vegetational structures within savannas have been appropriately referred to as "fringe forests" or "forest outliers" (e.g. Rosevear, 1953). Almost certainly forest inventory will reveal the potentially high commercial timber value of some trees in them.

The woody species of common occurrence along the banks of the Oli River include Terminalia macroptera, Diospyros mespiliformes and the generally big Daniellia oliveri. Common shrubs observed are Rotula aquatica and Mimosa pigra while the sedges Mariscus alternifolius and Killinga tenuifolia are widespread on the river bed.

Other seasonal rivers are Nanu, Uffa, Menai, Doro and Timo, the last three of which drain into the Kainji Lake, Nigeria's man-made lake. The five rivers usually maintain less sizeable water-holes than Oli does in the dry season.

It is along the banks of the Rivers Doro and Timo that Acacia variant trees come to their own while the other three rivers affect the vegetation on their courses in the same but to a lesser extent than the Oli.

Oli River commenced flowing in July, maintaining the current rather sporadically in the course of the study. The other rivers did not show any appreciable flowing during our observations.

2-1.3.4 Termites and Termitaria

Interest was aroused in the termites and their mounds because of the great abundance of the latter in the Northern Guinea Savanna in general and in the Park in particular. The mounds are more numerous and much larger than those in any vegetation zone lying to the south of the Northern Guinea Sub-zone. Baboons utilise the termites as protein food and their termitaria, both large and small are readily climbed by baboons presumably to have a better view of the surroundings or just to sit and rest.

Large termitaria (mounds) can be as high as 3.7 metres (4 yards) while the smaller ones are rarely more than a metre high. The former are built by Macrotermes spp. and the latter by Pseudocanthothermes spp. (Pomeroy, 1976). The distribution of termite mounds did not, according to Pomeroy (1977) coincide with that of temperature, rainfall or soil in Uganda.

Although opinions vary on the question of the extent of relative fertility of termite mounds compared with the surrounding soil, it is generally agreed that the contribution made by them is negligible (Hesse, 1955; Nye, 1955; Watson, 1962). However, termite activities may improve soil aeration Pomeroy, 1976) and may have significant effects on the physical and chemical properties of the soil (Pomeroy, 1977).

Tamarindus indica in KLNP is usually found associated with termite mounds. Baboons are fond of the fruit of T. indica as much as they are of taking to the termite mounds and they have perhaps contributed to the widespread dispersal of the plant. This view is strengthened, not proven, by the fact that T. indica seeds in baboon faeces freely germinate. Perhaps all that happens is that the mounds have accidentally been built around the trees (Nye, 1955) or that the plant T. indica simply behaves like the sisal in Tanganyika which generally grows better on termite mounds than elsewhere (Hesse, 1955): in either case the association between T. indica and termite mounds will have nothing to do with the baboons. The true position needs clarification by research.

Although T. indica appears to thrive well with termite activity, the situation is different with Afzelia africana. The trees of A. africana seem to have a special attraction for termites. The bark of some 60 per cent of the trees examined shows degradation due no doubt to termite activity. One of the trees was virtually dead, presumably as a result of termites eating their way into its wood.

Plate 8. Termite Mounds, Short and Tall, are an Integral Part of the Habitat of the Northern Guinea Savanna in which the Nigerian KLNP lies.

Since one of the factors determining fire-susceptibility is the condition of a plant (Thomas and Pratt, 1967) which can be weakened by termite activity, it may be that like the elephant (Afolayan, 1976a) and fire, termites are an important factor affecting the ecology of the KLNP. If the A. africana habitat is to retain its imposing splendour, the relationship between it and termites must be studied and necessary control measures taken, assuming that the association is not a case of commensalism that seems to be occasionally upset by other environmental factors.

2-1.3.5 Other Animals

Since other animals present are an integral part of an animal's environment (Andrewartha and Birch, 1954; Andrewartha, 1970; Clark et al, 1967) it is worth mentioning that in the KLNP nearly all major African tropical savanna animals are well represented. The checklist of these animals within the Park has been prepared by TDC (1972) and Child (1974).

The other animals apart from baboons constitute what could be termed "mobile biotic" factor of the baboon's environment. Each of the animal exerts one or another form of influence on one another and on the baboon populations. Where such influences were observed directly to affect baboon behaviour, they will be discussed later when dealing with "Baboons and Other Animals" under another chapter.

2-1.4 ABIOTIC (CLIMATIC) ENVIRONMENTAL FACTORS

2-1.4.1 Preamble

The most important climatic feature of the Nigerian tropical environment is the division of the year into two distinct seasons - dry and wet (rainy). The cool rainy season lasts usually from April to October. The remaining months are dry and relatively hot except when the very cold harmattan wind blows shortly before and after January.

2-1.4.2 Rainfall

Most of the annual rainfall in the Northern Guinea Savanna is about 53 in. (135 cm.) and falls during April to October, whilst in the remaining dry five months there is less than 1 in. (2.5 cm.) rainfall per month (Service, 1965). Rainfall data collected by Child (1974) from Nigerian Meteorological Services show that the mean rainfall at Wawa, the base of the KLNP Authority, is 47.8 in. per annum whilst the annual maximum and minimum are 56.6 in. and 35.1 in. respectively.

In the course of this survey (1977), April was virtually devoid of significant rains in the KLNP. May 29 recorded the heaviest rainfall but August had the largest number of rainy days. On the whole, May, June, July and September showed similar patterns of rainfall in which rainy days intermingled with dry rainless days. Rainfall was not uniformly distributed across the study area. This is probably due to its large size and vegetational heterogeneity.

2-1.4.4 Cloudiness

The degree of cloudiness was determined in the field using the 'okta' grading system (Meteorological Office, 1952). This consists in visually estimating how much of the total apparent area of the sky, to the nearest eighth, is covered with cloud. Three determinations were made daily at 8.00 hours, 13.00 hours and at 17.00 hours local time (G.M.T. + one hour).

The following, Table 1, summarises the results obtained for April to September, 1977.

Table 1. Atmospheric Cloudiness in the KLNP.

Month	Mean Cloudiness	Range of Cloudiness
April	0.62	0 - 4
May	5.49	3 - 8
June	6.27	0 - 8
July	5.55	0 - 8
August	7.72	2 - 8
September	6.17	2 - 8

The sky was most cloudless in April and most cloudy in August. Cloudiness varies from moment to moment.

2-1.4.4 Temperature

Hopkins (1974) gives the mean monthly minimum and maximum temperatures of the Guinea Savanna as 55° to 70°F (13° - 21°C) and 95° to 105°F (35° - 41°C) respectively. He (1974) concludes that the range is greater than is found in the forest zone.

The temperature figures for the KLNP between February 1971 and April 1972, obtained by Child (1974) are reproduced in Figure 3.

From figure 3, the absolute and mean maximum temperatures occurred in March and April, whilst the greatest diurnal range was noted in January and February (Child, 1974).

Howell (1968a) reports that temperatures as low as 36°F (2°C) were recorded in the River Oli valley of the KLNP during an uncomfortably cold harmattan period (mid-December to mid-February).

During this study, a room thermometer was placed in a screen near the Camp. The highest diurnal temperature recorded was 41°C (105°F) and the lowest, 23°C (74°F). April was the hottest month whilst the subsequent months were getting progressively cooler during the study period.

The temperature data in the Ecologist's Camp were not considered to be accurate enough to justify their inclusion here.

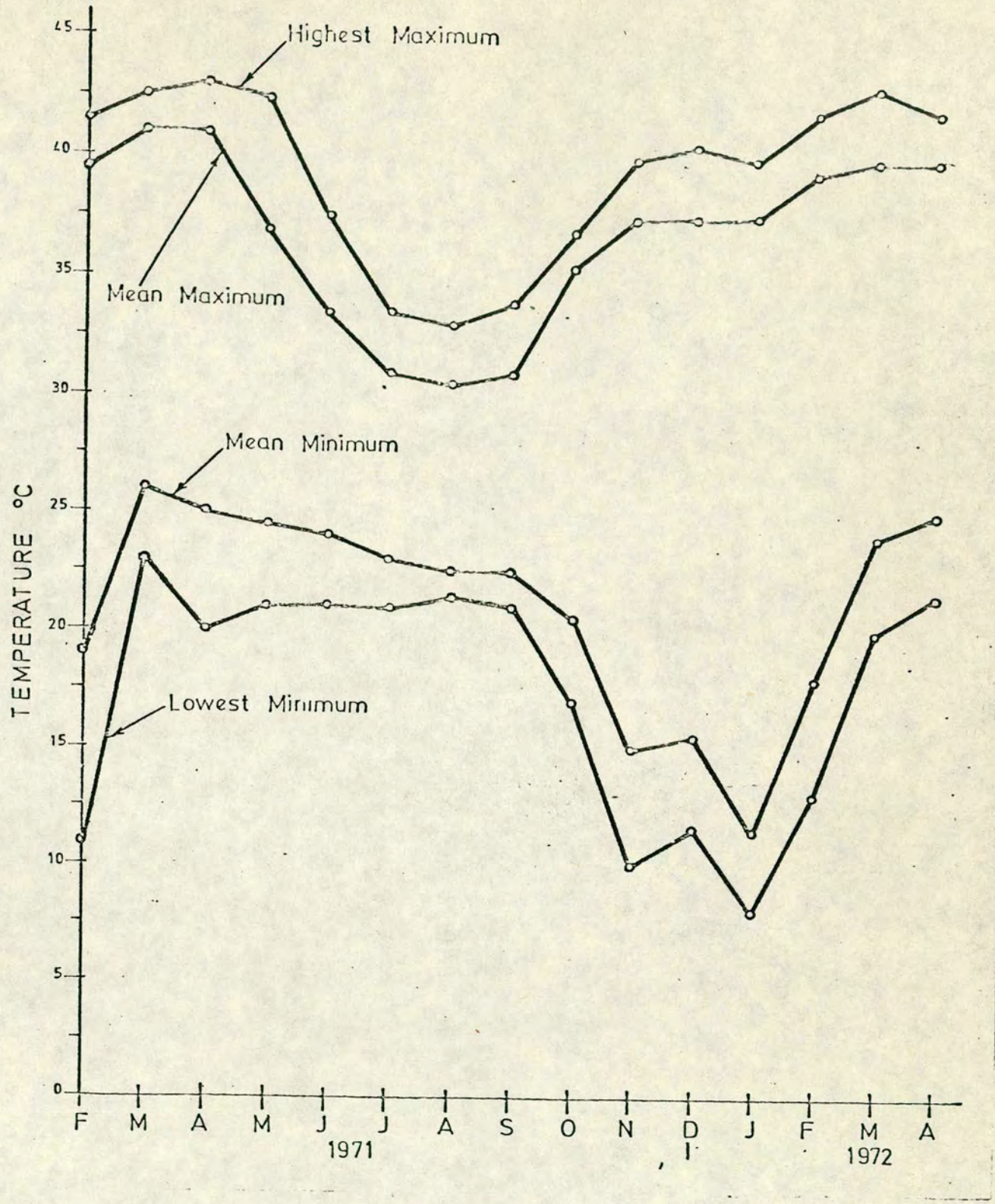


Figure 3. Temperatures in the Nigerian KLNP, February (F) 1971 - April (A) 1972. (After Child, 1974).

2-1.4.5 Relative Humidity

The relative humidity of the Northern Guinea Savanna is stated by Service (1965) to fluctuate from 23 to 69 per cent and from 44 to 94 per cent in the warmest and coolest months respectively.

Using the whirling hygrometer consisting of Mason's Wet and Dry Bulb. Thermometers, the following relative humidity figures were obtained during the study period:

Table 2. Relative Humidity in the KLNP

Month	Relative Humidity (Per cent)	
	Mean	Range
May (15th-31st)	59.67	41 - 84
June	70.28	52 - 95
July	69.97	47 - 91
August	77.91	58 - 92
September	78.11	58 - 95

At Ibadan lying in the Lowland Forest Zone of Nigeria (Clayton, 1958) the corresponding relative humidity figures for June and July were much higher, being 83.34 and 85.47 per cent respectively (Ogunwale, 1977).

2-1.4.6 Wind

The wind force was estimated using the Beaufort Scale system which classifies force from "calm" to "hurricane" (Meteorological Office, 1952). The wind force was generally "light" except for some four occasions in May/June when it was raining rather heavily. On those days, the force was a "moderate gale".

At Yelwa near the KLNP, southerly winds generally prevail from April to October and northerly winds from November to March (Child, 1974). The cold dusty harmattan wind from the north usually blows between mid-December and mid-February.

2-1.4.7 Fire

So profound has been the influence of bush-fires in forming and maintaining the African savanna vegetation that fire has become a limiting factor of almost equal importance to topography and climate (Glover, 1968). In fact, fire diversified the environment turning forests into grasslands (Darling, 1960) and any savanna floral species that fails to adapt to annual burning is doomed to extinction.

Annual burning is perhaps the only habitat management tool in KLNP. Hopkins (1963) has shown that fire promotes the sprouting of most savanna species and Afolayan (1976b) reports that complete elimination of burning from savanna habitats

results in bush-enchroachment producing more coarse grass species whilst desirable (for animals) grass species tend to disappear. After listing the merits and demirits of burning, Egunjobi (1976) contends that burning per se does does not lead to soil erosion and Cooper (1961) calls for the judicious use of fire as a tool in the management of the habitat.

The KLNP Authority utilises the early burning regime. This is generally accepted to be better than late burning (Howell, 1968; Egunjobi, 1975; Milligan, 1976).

Observations during this study indicate that most savanna species have adaptations for tiding over annual burning, although evidence of burning is conspicuous on the grasses and some trees. Burkea, and to a lesser extent Detarium invariably have charred barks. They are fire-tolerant. On the other hand Butyrospermum, Acacia, Terminalia, Isoberlinia and Afzelia are generally fire-resistant. Some plants like Gladiolus and Cochlospermum form storage tubers as an adaptation to drought and probably to annual burning.

2-2 BASIC METHODOLOGY OF STUDY

2-2.1 Gridding of the Study Area into Sampling Units

Geerlings (1976) 1 : 100,000 Vegetation Map of the Park was obtained as was its sketchy version prepared by the

Kainji Lake Research Institute. The latter was blown up to the size of the former to produce a Simplified Vegetation Map. All the river courses within the Park and the adjacent villages were then mapped on it, using Child's (1974) Map A as a guide.

The Simplified Vegetation Map represents some 4,000 sq. km. (1,562.68 sq. mls.) of land. Using the appropriate scale, it was gridded into 200 equal squares each of which represents about 4.47 km. by 4.47 km. or 20 sq. km. This is the unit area suggested by Child (1974) as containing, on the average, one baboon troop. The distribution of the 200 grid units across the five major vegetational sub-types A to E is shown in table 3, where the sub-types have been referred to as "PRIMARY HABITAT TYPES", a term to be hereafter applied to them. Each primary habitat type might be referred to simply by its appropriate letter prefix (e.g. A or D) instead of having to write the name of the dominant species.

2-2.2 Sampling Design: Stratified Random Sampling

Previous casual observations and the result of pilot trials during the study period indicated that the five major primary habitat types are heterogenous. The original intention to sample them proportionately had to be abandoned in order to allow for enough representation of the scanty ones and to avoid over-sampling the extensive types. Therefore the primary sampling units were disproportionately allocated to the five habitat types.

In stratified random sampling it is not compulsory to allot sampling units to the different strata on proportionate basis (Snedecor and Cochran 1967) and the problem of significant differences in proportions allocated may be tackled by the χ^2 test (Moroney, 1951). For the latter reason the χ^2 statistic was used to try and detect any significant differences in the proportions of sampling units allotted to each stratum. The allocation of sampling units across the five strata is as provided in table 3 and the value of χ^2 obtained in the test for disproportionateness of the allocation is 58.49. With a value of 58.49, 4 degrees of freedom and P much less than 0.001, it means there is a highly significant difference between the theoretical and actual allocation.

The implication of the significance of the above χ^2 value is that in order to compute the overall baboon population mean in the entire Study Area, the sample means in each stratum has to be weighted using the relative size of the stratum (Snedecor and Cochran, 1967). This important point is to be made use of later on when dealing with population estimation.

Having disproportionately allotted a reasonable number of primary sampling units to the five basic strata, the allocations within each stratum were secondarily stratified on the following basis:

i) the presence or absence of permanent source of water and,

ii) their proximity to any form of human settlements. Essentially, the ultimate distribution of the

sampling units within each stratum depends on the occurrence of factors (i) and (ii).

Next, appropriate numbers were systematically assigned to all the square units in each stratum. The ultimate sampling units were then randomly and independently drawn for each primary habitat type or stratum. The selection was done with the aid of a table of random digits (Snedecor and Cochran, 1967) adapted for use along the lines advised by Reichmann (1961).

Eventually, a total of 37 sampling units were selected by stratified random sampling. Their distribution is displayed in table 3. By the means of Geerling's (1976) Map, its Simplified Form and Child's (1974) Map A, coupled with observers' personal knowledge of landmarks in the study area, each sampling unit was

Table 3. Distribution of Stratified Random Sampling Units

Primary Habitat Types	Number of Grid Units		Breakdown of Sampling Units		
	Total	Sample	With permanent water	Without permanent water	Near Human Habitations
A. Burkea Terminalia	100	12	5	6	1
B. Acacia	50	9	5	2	2
C. Detarium	30	7	3	3	1
D. Afzelia	12	5	1	3	1
E. Isoberlinia	8	4	2	2	0
TOTAL	200	37	16	16	5

meticulously located on land using a marching compass and pedometer as aids. In each of the 37 sampling units we collected information on baboon population, its ecology and behaviour with the intention of relating these to the management of the animal. Details of methodology will be given under relevant sections.

2-2.3 The Merit of Random Sampling

One more-imaginary-than-real drawback to random sampling is the random sampling error which arises because animals are not completely evenly distributed across an area as this method basically assumes (Norton-Griffiths, 1975). As pointed out by Solomon (1976) this assumption may distort the actual effective density of the species under investigation. However, although "random errors will not go!" (Robson, 1973) one can measure the size of the random sampling error, thereby knowing how much confidence one can put on the sample estimates (Norton-Griffiths, 1975): providing of course that the error does not stem from the behaviour of the species which cannot be controlled under conditions of non-interference which we strictly adhered to.

Apart from being able to eliminate systematic error, random sampling has one major advantage over having to work on the whole of a population. This is that it saves much time without necessarily sacrificing accuracy. This statistical

fact, however, holds true only when the values of standard deviations and standard errors obtained are generally low. Fortunately, this is what they are in this report. In effect this implies that our stratified random sampling estimates enjoy a high level of statistical confidence.

CHAPTER 3

POPULATIONS

CHAPTER 3

P O P U L A T I O N S

3-1 COUNTING THE BABOONS

3-1.1 Baboons Are Difficult to Count

In general, animals in the wild are difficult to count accurately. Watt (1968) has discussed the nature of possible errors, a large part of which arises from the behaviour of the animal involved in relation to the observer and the nature of the habitat. Watt (1968) maintains that so great are the errors in practice that one should use, concurrently, several independent population assessments, each confirming or otherwise the other.

Baboons and similar primates are no exception. De Vore and Hall (1965) state possible reasons why baboon troops are difficult to count as follows:

i) the large size of some troops makes counting confusing and this is often worsened by the tendency of the animals to cluster

ii) the fact that a single troop may temporarily sub-divide into foraging parties could lead to gross under-estimation and,

iii) infants riding on their mothers' bellies are difficult to see at any distance

Observations during this study confirmed the above points on baboons. In addition, the tendency of some individuals,

usually males, to change troop affiliations (Packer 1975) increased the error in the counts. Opportunities for counting baboons in an area which is not open are very rare (Rowell, 1966) due to the reluctance of the baboons to come to the open or cross roads.

There are difficulties too in determining the composition of a baboon group. Older juvenile males may be mistaken for adult females as a result of their similarity in size. This may lead to an error in estimating the sex ratio of adult males to females. The ratio of adult to young may be easily under-estimated because some juveniles repeatedly cross a visually-demarcated census point. They are curious and active, thereby making themselves un-necessarily conspicuous.

3-1.2 Guide-lines for Census Accuracy

All possible precautions were taken in order to minimise, if not eliminate, the errors already referred to. We did repeated counts of each troop as advised by De Vore and Hall (1965) who also assert that baboon counts by more than one observer at a time are indispensable. Census figures were obtained whenever the group was crossing either a road or an open strip usually more or less in a single file. Juveniles recrossing the counting point were accounted for in arriving at population figures at every counting.

Plate 9. Baboons Are Best Enumerated When Crossing an Open Area or a Road. They usually do so singly.

In order to arrive at an accurate figure of troop composition the following developmental stages and features of baboons, after Hall and De Vore (1965) and Rowell (1972), were used:

1. New-born baboon .... 0 - 1 month

These are babies which hold on below their mothers and suckle. Their bright pink skin is covered by a black natal coat.

2. Infant .... 1 - 6 months

Between its first and fourth month, the baboon baby begins to ride dorsally on its mother though it still continues to cling to her ventrally. At about the third month the skin starts to darken and from the fourth month onwards the fur colour changes from black to light brown. The infant learns to eat some solid food.

3. Juvenile . .... 2 - 4 years

At second year of birth, the baboon shows increased independence on its mother and spends most of the day with peers in feeding and playing. As from its third year the juvenile shows transition from the young partly-dependent baboon to the independent young adult. By the end of its fourth year the female is essentially an adult and could become pregnant while its male counterpart is quite clearly still a juvenile.

4. Adult Female ... ... 4/5 - 8 years

The growing female juvenile gradually attains its full adult form from its fourth to eighth year. At year seven or eight, the adult female could be found with her second infant.

5. Sub-adult Male . ... 4/5 - 8 years

As from its fifth year, the older male juvenile becomes larger than the adult females over whom it establishes dominance. He is pugnacious within the group and 'daring' in his behaviour generally, although he tries to avoid the full adult males who are still much bigger. By his seventh year the male has reached his full height and has his full dentition but continues to develop in his breadth and in the quality of his mane for another year or two.

6. Adult Male ... ... 8 years and upwards

Sub-adult male now shows full skeletal and muscular growth, complete eruption of the formidable canine teeth and the development of the shoulder mantle. We observed that they look calm and confident within the troop.

Using the above criteria the observational problem of accurately determining the ratio of adult to young was practically removed. The difficulty of sexing in the field was surmounted by close observation of baboon bottoms which show sexual dimorphism. The female baboon has two distinct

ischial callosities which Hall (1962a) has referred to as "sitting pads of horny epidermal thickenings". The callosities of the male usually fuse completely across the middle line below the anus. Although Hall (1962a) says the difference is perfectly clear in the field even in the young animals our observations did not confirm this view. This error might be due to the tendency of the juveniles to jump about and face rather than back us or it could have been due to insufficiently adequate visual acuity on our part, or again, to a combination of both factors. This failure was in spite of our patience.

To cope with the vagary of juveniles which could lead to their overestimation, one observer was assigned to recording the number of back-crosses made by them across an opportune counting point.

3-1.3 An Examination of Feasible Census Methods and the Choice of One

There are various methods for counting animals and the one to be used for any census excercise depends on the animal. Giles (1969) has given a list of census methods for field use. Perhaps the best method consists in counting all the animals in the habitat but this is usually unpracticable for reasons of time and nature of habitats. As Andrewartha (1970) has pointed out, one usually has to rely on some method of sampling in which only a small proportion of the animal population is seen.

The census method within the reach of this investigation was by ground counts. The use of aerial census is precluded not only because of possible visibility problems and the small size of the baboon but also because it will not allow for a continuous observation of the condition and behaviour of the baboon troops (Norton-Griffiths, 1975). On the other hand, ground counts are limited when ground access proves difficult or when the sample/total area to be covered is very large.

Only two options of ground counts seem feasible for our counting exercise. These are direct counts made by walking, otherwise called naturalistic search approach, the second one being road strip count. Hirst (1969) reports that direct counts made by the first option have given poor results in the Lowveld Woodland of South Africa. He favours the road strip census. Dasmann and Mossman (1962) state that road-strip counts would usually under-estimate game numbers while Hayne (1949a) is of the opinion that the road strip method may increase, not under-estimate, the apparent population density.

Apart from the controversy on the direction of error which road-strip counts could produce, the method appears limited by a number of reasons. In the first place roads are rarely distributed randomly across an area (Norton-Griffiths, 1975) as we realise in the case of the KLNP. Secondly, the

available roads may be far removed from water sources and so might not form part of the home-range which the baboons usually confine themselves to. The third factor against the use of road-strip counts is that roads may be temporarily or seasonally rendered inaccessible by such things as flood or fallen trees. This is commonplace occurrence in the Park. Finally, the use of roads as counting strips rules out following the animals to points removed from such roads. Thus continuous observations on baboon behaviour will be impossible. All these reasons suggest that even if the use of road-strip census does not fail to sight baboon troops, it will certainly not allow continuous observations of their behaviour.

As pointed out by Caughley and Goddard (1972) all direct counting methods have their limitations. With foot counts it seems that a major limitation which it has in common with road-strip counts is that the area it can cover will be necessarily small. Fortunately, this could be largely overcome by stratified random sampling which this study has used.

3-1.4 Census Procedure

Using the above method, information on baboon populations inside the Park was gathered as detailed below.

Each sampling unit was systematically searched on foot for watering places, tree clusters, rock outcrops and baboon

traditional paths which it might contain. Baboons are habitual drinkers of water (Hall, 1966), they use more or less traditional paths (Kummer, 1971; Rowell, 1972) and are known by personal experience to be fond of tree clusters and rock outcrops. Silence was reasonably maintained as the team moved along in order to catch any baboon barks. Thus we employed the naturalistic search method of looking for water and other habitat factors liked by the baboons in an effort to locate baboon troops. Where water was available, the idea of looking for it in order to look for the baboons saved us a lot of time and effort. Invariably, the baboons were usually located coming to such waters.

On sighting a baboon troop, it would be numbered and enumerated as soon as an opportunity arose. The censusing was done along the following lines:

1. total by rapid straight count of heads by means of counters
2. number of adult females
   - i) with babies under their bellies
   - ii) with infants on their rumps
   - iii) pregnant or with anal sexual swellings
   - iv) others (not in i) - iii) above)
3. number of infants
   - i) babies on mothers' bellies
   - ii) infants on mothers' rumps
4. number and possibly sex of juveniles

5. number of sub-adult males

6. number of adult males.

For reasons earlier given, we did not succeed in determining the sex of the juveniles. Anyway, that difficulty had been envisaged when the investigation was being planned. What was not envisaged but proved impossible was the ability to identify a pregnant female baboon.

Each time a troop was enumerated, the group-stable adult females were always critically examined noting their composition and special features or marks that they might bear. This exercise was meant to and did eliminate duplicated counting of a troop. Counting of a troop was done at rare opportune times already referred to. Counts taken at other times are certain to be inaccurate and although we made a few such counts initially, experience later showed that the demographic information resulting therefrom was virtually useless and had to be discarded.

3-2 RESULTS OF POPULATION CENSUS

3-2.1 Troop Size and Frequency Distribution

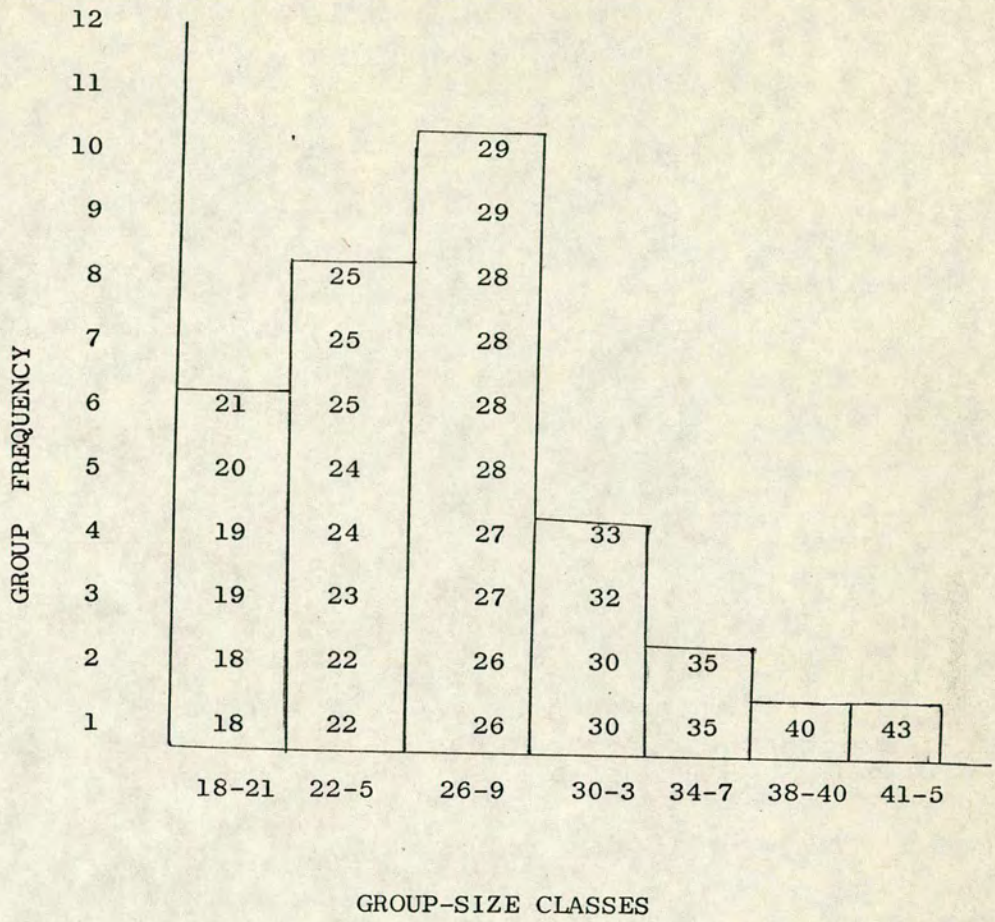
In all we encountered 32 baboon groups. Their distribution across the five major habitat types is shown in the accompanying table 4.

Table 4. Troop Distribution in the Habitat

HABITAT TYPE	A. Burkea-Terminalia	B. Acacia	C. Detarium	D. Afzelia	E. Isoberlinia
No. of Sampling Units	12	9	7	5	4
No. of Troops	16	4	3	5	4
Troop Size Range	20 - 43	18 - 22	18 - 22	28 - 40	26 - 35
Total No. of Animals	444	80	59	158	118
Group Mean Size	27.75	20	19.67	31.6	29.5
Standard Error	1.37	0.91	1.2	2.29	2.02
Standard Deviation	5.46	1.82	2.08	5.13	4.04

The size distribution of the 32 troops censused is displayed in figure 4 in which the troop sizes have been arbitrarily grouped into classes.

Figure 4. Histogram of Size Distribution of the 32 Baboon Troops Censused



(Individual group sizes and their frequencies are written in the appropriate ladders of the histogram).

The frequency distribution of the group size classes shows that the smallest two troops encountered each had 18 animals while the largest troop consisted of 43 individuals. The histogram suggests a positive skewed (i.e. asymmetrical) unimodal distribution with the mode in the frequency class of

26 to 29 individuals. Although the mode by itself could prove misleading (Reichmann, 1961) especially in a case like this where the grouping into frequency classes is arbitrary, it is interesting that the mean of the ungrouped data is 26.84 animals and this corroborates the modal value.

Differences in troop size will be accounted for in subsequent discussions.

3-2.2 Pattern of Troop Distribution in the Habitat

The basic assumption of stratified sampling is that the component strata are characterised by some form of heterogeneity. Failure to reflect this in the results might indicate that either the stratification exercise is not justified or that the available data are too limited to reveal the heterogeneity. This section of the report tries to find out if the distribution of baboon troops indicates habitat heterogeneity as this and other investigations in the Park presuppose.

There are variations in the manner in which the 32 troops are distributed among the five primary habitat types in the Park (vide: table 4). It is true that there are differences in the detectability of baboon troops in the different five strata (otherwise referred to as primary habitat types) but these are not thought to introduce an

appreciable bias. Similarly the difference in the proportions of sample units surveyed does not invalidate statistical inferences (Snedecor and Cochran, 1967).

The 32 troops encountered are distributed in the proportions of 16, 4, 3, 5 and 4 respectively across the habitat types, A, B, C, D and E in that order (vide: Table 4). If under a null hypothesis, Ho, there was no tendency for the baboon groups to favour the habitat types differentially their distribution would be at random, and allowing for the differences in the sample size, each habitat type would be expected to contain the same number of troops. Using the χ^2 statistic, the probability of the observed dispersion differing significantly from that expected under Ho was calculated. With χ^2 equal to 6.618 and the degree of freedom (d.f.) equal to 4, the probability of Ho being true is greater than 0.05: (χ^2 value in appropriate table is 9.488). In other words, the null hypothesis is not upheld at 5 per cent significance level, meaning that the troops did not show any significant preference for any of the habitat types.

When the habitat types are matched against one another in all possible combinations, the χ^2 test is expected to be more sensitive to any differential selection of habitat that might occur. The results of this exercise are displayed in table 5. As in preceeding case, Ho is used as premise of analysis.

Table 5. Statistics of Preferential Habitat Selection by 32 Baboon Troops

Matched Habitat Types	Calculated Value	d.f.	Table Value at 5% Level	Result	Interpretation
A vs B	4.266	1	3.841	$P < 0.05$	A is significantly preferred to B
A " C	3.620	1	"	$P > 0.05$	No significant preference for either
A " D	0.317	1	"	"	"
A " E	0.267	1	"	"	"
B " C	0.002	1	"	"	"
B " D	1.543	1	"	"	"
B " E	1.388	1	"	"	"
C " D	1.429	1	"	"	"
C " E	1.297	1	"	"	"
D " E	0.000	1	"	"	"

The results show that except for the single case of habitat type A being significantly preferred to type B, the baboon troops observed show no significant preference for one habitat type over another. It is to be pointed out however, that the analysis reveals that the baboon troops do show some measure of preferential selection for some habitat types. The only exceptions to this general trend are found in comparisons

between habitats D and E, B and C, A and E and finally in A and D, all of which have almost negligible χ^2 values.

Crook and Aldrich-Blake (1968) have made a similar analysis of the preference of baboons for different habitats. They used the individual animal as the unit of analysis. This seems inadmissible in a species that lives in close-knit groups. The unit of study and analysis is the troop and this is what has been used in this report. Consequently this difference in analysis precludes a valid comparison between their results and mine.

The conclusion then is that within the limitation of the data, baboon troops show no preference for any of the five primary habitats. The next aspect of result analysis will be on troop size variation in the habitat.

3-2.3 Differences in Troop Mean Sizes in Relation to Habitat

Although the last section of this report indicates that baboon troops show no significant preference for particular habitats, the size of baboon troops does vary between habitats.

Troop mean sizes across the habitat have been found and the values are matched against one another in all ten possible combinations. Each combination is then subjected to the 't-test for small samples' (Bailey, 1964). The results are presented in the accompanying table 6.

Table 6. Results of Test for Differences in Troop Mean Sizes Across Habitat Types

Matched Habitat Types	No. of Troops	Troop Mean Size	t Value and its Probability	dif	Inference on Troop Mean Size
A vs B	16 vs 4	A:27.75	2.749<0.05	18	Significantly larger in A
A " C	16 " 3	"	2.480<0.05	17	"
A " D	16 " 5	B:20.00	-1.392>0.05	19	No significant difference
A " E	16 " 4	"	-0.596>0.05	18	"
B " C	4 " 3	C:19.67	0.224>0.05	5	"
B " D	4 " 5	"	-4.263<0.05	7	Significantly larger in D
B " E	4 " 4	D:31.60	4.285<0.05	6	Significantly larger in E
C " D	3 " 5	"	-3.750<0.05	6	Significantly larger in D
C " E	3 " 4	E:29.50	-3.791<0.05	5	Significantly larger in E
D " E	5 " 4	"	0.667>0.05	7	No significant difference

As usual in this report, Ho has been used as premise of analysis and the results interpreted for significance at five per cent level. The results show that the null hypothesis, Ho, holds true in four instances and has been rejected in six others.

There are significantly larger troop mean sizes in habitats D, E and A in that order in contrast to B and C types. Types D, E and A are not significantly different in troop mean sizes of the baboons found in them just as the less-favoured habitat types B and C contain troops with nearly the same mean size values.

The above observations are hardly surprising. Similarity of habitat types D (Afzelia) and E (Isoberlinia) is visibly striking and Milligan (1976) has used the sample plot and species ordination analysis to confirm this view. Habitat type A (Burkea-Terminalia group) readily inter-digitates with and in fact surrounds the two similar types D and E. Visibility, it has been previously pointed out, is best in habitat type E closely followed by type D and then type A. There are thus great similarities in habitats D, E and A, and from the viewpoint of the baboon, they may be thought of as functionally the same.

The other two habitats, B (Acacia) and C (Detarium) are almost structurally similar and both are charaterized by generally poor visibility. These facts probably account for the similarity in their troop mean sizes which have been shown to be significantly lower than in the other three habitat types A, D and E.

A number of reasons could be suggested in an attempt to justify the results under discussion. The first is that visibility seems important in determining troop size. In an animal like the baboon which relies heavily on its keen eye-sight, the better the visibility of an area, the more the animals will tend to concentrate there. This behaviour should enable the animals to detect potential predators or other forms of danger much faster than they would in an area with poor visibility. Hence there will likely be a relatively high baboon density in those habitats with good visibility. Within the limitation of habitat resources, a high density might, though not necessarily, lead to the formation of large troops.

Apart from environmental conditions, a factor that may be important in determining group size is the behaviour of the species. De Vore and Hall (1965) have suggested that the social behaviour of the animal is the more important variable except where marked differences in altitude occur in the former. They however do not state in what way environmental altitude is a variable. Although Altmann and Altmann (1970) have argued that troop size should not be related to social behaviour and to local environment as alternatives and that they are but two different aspects of the same phenomenon, the point is that the two factors are related to group size.

A third reason which may possibly cause variations in troop size is differential availability and dispersion of food/water resources across the habitat. Hall (1965b) has attributed regional variations in group size primarily to "acreage density of available food" and Altmann and Altmann (1970) have reported that supplemental food supply is known to steadily increase the group size of the Japanese macaques, *Macaca fuscata*. The fact that the baboons and the macaques are clearly similar (Hall, 1966) raises the possibility that where a particular habitat type produces supplemental food over and above another type, baboon troop size in the former might exceed that in the latter.

Schoener (1971) has reported that in gelada baboons, troop size parallels food abundance very closely. A similar relationship has not been reported for the olive baboons - as far as I know. This is probably because as pointed out by Altmann and Altmann (1970) the group size/food relationship is very much complicated by other factors of the environment and of course by the behaviour of the species.

Since water availability, an aspect of food resources, is somehow easy to quantify in the field, its effect on troop size will be dealt with in the next section.

3-2.4 Troop Size Variation in Relation to Availability of Permanent Water

Baboons need water.

The Yoruba people of Nigeria have long recognised this fact and there is a time-worn story of a Yoruba hunter who got stranded in the bush and was without water to drink for a number of days. He got hold of a baboon and tied it to a tree for about 24 hours. On releasing it, the animal ran off straight to the nearest source of water to the joy, and expectation anyway, of the stranded hunter who then had water he so badly needed.

The 32 troops encountered vary in size from 18 to 43 animals per troop. The troop mean size in areas near a permanent source of water varies from 21 to 43 animals while the variation is from 18 to 29 baboons in areas where water is not permanently available. If all the habitat types are lumped together, the average troop size in places where water is permanently available is 30 ($\pm$ 1.56) while it is 23.69 ($\pm$ 0.94) in areas without permanent source of water.

In view of the fact that this report has already shown that from the standpoint of the baboons, habitats A, D and E, likewise B and C, can be thought of as a functional unit, the effect of permanent water on troop size will be determined on the basis of each such unit. The first unit made up of habitats A, D and E contains 25 baboon groups while the second unit which consists of habitats B and C contains 7 troops.

In habitats A, D and E, the 25 troops are distributed in relation to permanent water as shown in table 7.

Table 7. Troop Size Distribution in Relation to Permanent Source of Water.

Areas with Permanent Water		Serial No.	Areas without permanent water	
Habitat Type	Troop Size		Habitat Type	Troop Size
	43	1		26
	35	2		24
	32	3		25
	27	4		20
	25	5		23
	29	6		24
	30	7		25
	28	8		28
	28	9		29
	40	10		28
	33	11		27
	35	12		26
	30	13		
Troop Mean Size	31.92			25.42
Standard Deviation	5.22			2.50
Standard Error	±1.45			±0.72

In thethree habitats, the troop size range in areas with permanent source of water is between 25 and 43 animals while the value ranges between 20 and 26 in areas without such water. This suggests, just as the mean sizes do, that the presence of permanent water tends to be associated with larger troop size. The statistical significance of this empirical observation will next be determined using the 't test independent samples statistic' (Robson, 1973). The result of the test shows that the occurrence of permanent source of water has a highly significant positive effect on troop size ($t = 3.916$; $P < 0.005$; $d.f. = 23$). This means that in the habitats A, D and E treated as a unit, baboon troops attain significantly larger group size in the vicinity of permanent water than they do in its absence.

In the other two habitats B and C containing seven troops, the troop size in areas having permanent source of water ranges from 21 to 22 animals while the range is between 18 and 19 in other areas. The corresponding troop mean sizes are 21.67 and 18.5 baboons respectively. These data, though scanty, suggest that just as in the case of habitats A, D and E, the presence of permanent water in habitats B and C tends to be related to larger troop size. Using the t-test as in the case above, the result shows an even higher significant positive correlation between permanent water and troop size than does the above result in

habitats A, D and E - ($t = 7.188$; $P < 0.005$; d.f. = 5). Thus, in habitats B and C, like in A, D and E, larger troop sizes are obtained in areas with permanent source of water.

The results show that in the KLNP, baboon troops attain significantly larger group sizes in areas with permanent source of water than they do in areas without it.

3-2.5 Dispersion of Baboon Troops in Relation to Man

On the question of whether or not baboons are intimidated by human settlements, literature unequivocally answers "no" (e.g. Hall, 1965a) and, Crook and Aldrich-Blake (1968) have even shown that baboon troops significantly prefer cultivated areas to uncultivated ones. The foregoing statements need a qualification: the baboons must be those enjoying a large measure of protection.

Using the χ^2 statistic, the probability for preferential selection by baboons of areas with human settlements was examined. In this analysis comparison is made between only areas with permanent source of water, thereby removing complications that could arise from factors other than human habitation. Sixteen troops are involved. The results, based on null hypothesis, Ho, indicate that the troops did not show a significant preference for the few areas containing human settlements ($\chi^2 = 1.652$; $P > 0.05$; d.f. = 1). It is to be emphasised that the troops involved are legally protected.

However, where baboons are not protected and are subject to molestation by man, they are more likely to keep away from human beings. It was to verify this hypothesis, that some of my field assistants were occasionally sent to look for baboons outside the Park where the animals are not effectively, if at all, protected. They employed our naturalistic search approach and in addition interviewed the natives to determine the occurrence of baboons near their cultivated villages. They ended up with no single sighting, evidence or report of baboons in such areas. Howell (1968b) has observed that baboons are poisoned and killed by Borgu natives living around the Park.

Although baboons are rare outside the Park in Borgu area, two other monkey species are found there. These are the red patas, Erythrocebus patas and the green monkey, Tantalus guenon. Both groups of monkey are shy within and without the Park and we had no report of crop raids by either of them. This is probably why their presence is tolerated outside the Park while that of the baboon is not.

3-2.6 Baboon Density in Relation to Habitat

If the baboon population were spread uniformly across its available habitat, a single population density would emerge for the entire study area. A previous section of this report has shown that the populations observed did not completely

show uniform dispersion throughout the Park. For this reason of uneven dispersion, Solomon (1976) has cautioned that the average density over the whole area may be "an unrealistic guide to the effective density which the organisms experience". In order therefore to overcome this situation, the various densities of the baboons across the five habitat types have been determined. The results are presented in table 8, which also contains the overall estimations based on the sample of 37 units.

Table 8. Variations in Baboon Density in Study Area.

Habitat Type	Troop Density per 20 sq. km.	Density of Individual Animals per 20 sq. km.
A	1.33	37.00
B	0.44	8.89
C	0.43	8.43
D	1.00	31.60
E	1.00	29.50
Overall	0.865	23.22
Standard Deviation		10.84
Standard Error		$\pm$ 1.78

There is variation in the densities of the baboon from one habitat type to the other. The value is highest in

habitat type A and lowest in type C, being 1.33 and 0.43 troop per sampling unit (20 sq. km.) respectively. The values for other habitat types are as shown on the table 10 which also contains all corresponding densities per sq. km. In another column, the number of animals per sampling unit are given and the last column contains the corresponding individual animal (not troop) densities.

The results show that the densities, whether on troop or individual animal basis, are highest in habitat types A, D and E in that order while they are lowest in types B and C.

3-2.7 Water Source in Relation to Baboon Density

The positive relationship between the presence of permanent water and baboon troop size has already been shown. The relationship between the former and troop density is as shown in the accompanying table 9. The results show that troop density is similarly affected by the presence or otherwise of permanent water in the habitat.

Using the t-test statistic, the results show that $P < 0.05$. This means that troop density like troop size is significantly higher near a source of permanent water than away from it ($t = 2.518$; $d.f. = 35$).

Table 9. Variations in Baboon Density in Relation to Presence or Absence of Water

Type of Sampling Units	With Permanent Water	Without Permanent Water
No. of Sampling Units	13	24
No. of Troops	16	16
Troop Mean Density/ 20 sq. km.	1.231 ± 0.257	0.667 ± 0.098
Standard Deviation	0.926	0.482
Troop Mean Density/km^2	0.062 ± 0.013	0.033 ± 0.005
Standard Deviation	0.046	0.024

Incidentally, all the major studies which somehow involve baboons of the KLNP are unanimous on this observation that baboon density parallels the presence of permanent water (vide: table 10). As usually happens however, there are discrepancies in the figures of the different observers. The differences in the various figures obtained could be due to a number of reasons the most important ones probably being as a result of

i) data scantiness of any or all observers

Table 10. Effect of Water Source on Baboon Troop Mean Density/km^2 Obtained by Different Observers in the KLNP

Habitats with source of Permanent Water	Habitats without source of Permanent Water	Study Period	Observer/ Authority
0.198	0.099	1970/71	Child (1974)
0.430	0.18	1976	Milligan (1976)
0.062	0.033	1977	This Study

ii) variations in the acuity of different observers

iii) differences in method of data collection and probably of analysis

iv) time lapse between observations and,

v) the extent and distribution of permanent sources of water in the course of each investigation.

The last point (v), may be illustrated by a fact which also justifies point (iii). It is that whereas Milligan (1976) essentially confined his observations to the centre of the Park and so had only River Oli supplying a permanent source of water, this study was randomly spread throughout the Park and it therefore had extra sources of permanent water from Timu and Doro rivers. Probable reason (ii) is ably illustrated by

Child's (1974) report of sightings of baboon troops with much higher number of animals (>50) than my investigating team ever sighted up to the time of writing this report. Point (iv), time lapse, is clearly interwoven with population dynamics and factors like predation, epidemic outbreak and poaching, or other forms of mortality could have come into play between one observation and the other. On probable reason (i), one might point out that more data usually though not always lead to modifications in interences and conclusions earlier reached. This suggests that there is need for more data on this subject.

However, in spite of the differences in figures of the three reports, the inference is the same and shows that the availability of permanent water is related to high density of the baboons.

3-2.8 Over-all Baboon Density

The weighted troop mean size of the KLNP baboon is 33.15 animals and the total population is 5,734. From these figures, the density of the baboon in the Park boils down to 0.865 troop or 28.67 animals per 20 sq. km. This corresponds to 0.04 troop or 1.43 baboon in every km^2.

The overall density of 1.43 animal per km^2 is not far from that (2.04) estimated by Child (1974). Both figures indicate that the baboon density in the KLNP is relatively low when compared with the general density of 5 - 15 animals reported by Dunbar (1977) for olive baboon or with the highest value of 34 olive baboons per km^2 so far recorded in literature as obtained by Aldrich-Blake et al (1971) in an arid region in Ethiopia.

3-2.9 Total Baboon Population in the KLNP

In computing their total population, the weighted troop mean size of the baboons will be used. The latter will therefore be determined first.

3-2.9.1 Overall Troop Mean Size

The overall arithmetic mean troop size of the KLNP baboon as computed from the approximate means of the size of the troops ~~animal~~ in the five primary habitat types is 25.70 animals. This mean troop size is necessarily lower than that - 26.84 animals - estimated from the entire sample population. These facts are displayed in table 11. In view of the fact that sampling units were disproportionately allocated to the five habitat types, an arithmetic mean cannot be a statistically correct estimate of the mean size of the animals. This fact has been earlier mentioned as due to Snedecor and Cochran (1967).

Table 11. Baboon Population Means: Arithmetic and Weighted

Habitat Type (Stratum)	Sample Population	Arithmetic Mean	Weighted Mean
A	444	27.75	6.25
B	80	20.00	12.50
C	59	19.67	10.00
D	158	31.60	2.40
E	118	29.50	2.00
Overall Mean Size	26.84	25.70	33.15
Standard Deviation	6.00	5.53	4.62
Standard Error	$\pm$1.06	$\pm$2.47	$\pm$2.07

The statistically correct overall population mean for stratified random sampling in which samples are disproportionately allotted is given by the formula

$$\bar{y}_{st} = \frac{\sum Nh\ \bar{y}h}{N} \qquad \text{(Snedecor and Cochran, 1967)}$$

where: $\bar{y}_{st}$ is total population mean in all strata

Nh is the total number of sampling units in the h^{th} stratum

$\bar{y}h$ is the sample mean in the h^{th} stratum.

$N = \sum Nh$ is the size of the population

This formula allows the sample means to be weighted in the respective habitat types which constitute the strata. The weighted overall population mean is the sum of the weighted sample means of all the strata, in this case the primary habitat types.

The weighted overall population mean as computed by weighting the sample means is shown in table 11. The value is 33.15, meaning that the projected size of the average baboon troop in the study area is 33.15 animals S.E. = $\pm$ 2.07).

3-2.9.2 Computation of Total Population

Having determined the weighted overall troop mean size of baboons, the total population of the animals in the Study Area could be computed from the equation

$$\frac{32}{37} \times 200 \times 33.15$$

where $\frac{32}{37}$ = fraction of sampling units containing troops

200 = total number of sampling units and,

33.15 = weighted mean of the troops.

This corresponds to 5,734.05, meaning that the total baboon population in the Study Area as computed from this study is 5,734 animals ($\pm$ 358).

3-3 Composition of Troops and Sex-Age Ratio

The 32 baboon troops enumerated consist of 859 animals. Only nine of the 32 troops were thoroughly censused, the numerical strength of the others being determined by rapid count of heads three times each. The nine troops whose compositions will be discussed were each censused at least ten times.

3-3.1 Adult Sex Ratio

Sexual dimorphism is conspicuous in the baboons where the adult males are characterised by relatively large body size, formidable canine teeth and general robustness. Unless otherwise stated, adult males are both full adult males and the sub-adult males who are their immediate subordinates in rank.

The sex ratio of the adult baboons in the nine thoroughly censused groups is given in table 12. The census frequency for each troop is also given; these counts were spread over the period between 6th April and 30th September, 1977. As has been emphasised, reliable counting of any troop was done as rather rare opportunities presented themselves. In view of the slight differences in their size and the commonly-reported greater ones in their social roles within the troop organisation, a separate table, numbered 13, has been prepared breaking down the adult males into full adult and sub-adult males.

The over-all sex ratio of adult males to adult females is of the order of 1 : 1.67 for the nine troops. This ratio varies from troop to troop and ranges from 1 : 0.80 to 1 : 2.33

Table 12. Sex Ratio of Adult Male to Adult Female

Habitat Type	Troop No.	Troop Size	Census Frequency	Male	Female	Ratio	Habitat Type Mean Ratio
A	A1	43	21	7.27	14	1 : 1.93	1 : 2.04
A	A12	23	13	3	7	1 : 2.33	
B	B1	18	12	5	4	1 : 0.80	1 : 1.33
B	B2	22	13	4	8	1 : 2.00	
C	C1	22	10	6	7	1 : 1.17	1 : 1.17
D	D1	28	33	4	9	1 : 2.25	1 : 2.25
E	E1	35	10	6.44	11.78	1 : 1.83	
E	E2	27	14	5	10	1 : 2.00	1 : 1.67
E	E3	30	18	7	9	1 : 1.29	
Mean				5.30	8.86		
Overall Ratio				1	1.67		

Note: The mean sizes of the two sexes have been used in computing the overall adult sex ratio. Adult male mean size is 5.30 per troop (S.D. = 1.453; S.E. = $\pm$0.484) while in the female it is 8.86 (S.D. = 2.906; S.E. = $\pm$0.969).

Table 13. Ratio of Full Adult Male to Sub-adult Male

Troop No.	Full Adult Male	Sub-adult Male	Ratio
A1	4.27	3	1 : 1.07
A12	3	0	1 : 0.00
B1	2	3	1 : 1.50
B2	3	1	1 : 0.33
C1	4	2	1 : 0.50
D1	4	2	1 : 0.00
E1	3.44	3	1 : 0.87
E2	3	2	1 : 0.67
E3	4	3	1 : 0.75
TOTAL	30.71	17	1.81 : 1.00

While the counts in each habitat are few there is nevertheless no indication that different habitats show a different sex ratio; the difference in ratio is as great within as between habitats. Nor is there any obvious relationship between troop size and adult sex ratio.

The only consistent fact in these data is that adult females almost always outnumber adult males. Since it is likely, though not demonstrated, that the sex ratio at birth is 1 : 1 or near, there must either be a differential mortality in the sexes which falls more heavily on the males or a differential migration. The absence of bachelor parties and of considerable differential emigration suggests that the difference in number of adult males and adult females is likely to be due to different death rate in the sexes. This is discussed more fully towards the end of chapter.

When the nine troops are pooled on habitat basis resulting in five instead of nine ratios, the adult sex ratio range is from 1 : 1.7 to 1 : 2.33 for adult males to females. There is no reason to relate the variation in the ratio to the structural differences in the habitat types. While it is true that habitat types B and C which both have poor visibility account for the two lowest ratios, it is not a sufficient reason to associate low male number with poor visibility in a habitat. The factors likely to be responsible are those outlined in the preceding paragraph.

Table 13 shows that the ratio of full adult males to sub-adult males is 1.81 : 1.00. This varies from troop to troop but in all cases except one, the full adult males out-number the sub-adult males. The one exception, troop B1, is different from all the others. It is the smallest - consists of 18 animals - it has the lowest ratio of adult males to adult females and has more sub-adult males than full adult males. These facts suggest that it is unusual and atypical and may have suffered losses by death and/or emigration or has recently been formed.

3-3.2 Number and Ratio of Old to Young

Table 14 gives the numbers and ratio of old baboons to young ones in the nine troops that were thoroughly censused. 'Old' in this context means any baboon that is distinctly mature while 'young' refers to the immatures made up of juveniles, infants and babies.

The overall ratio of old baboons to young ones is 1 : 0.95. The ratio varies from habitat to habitat just as it does from troop to troop. The overall ratio has been estimated from data on only nine troops and we certainly saw more troops with greater number of young than old instead of what the scanty data in the table suggest. For this reason the above ratio should be treated with caution and it is suggested that the ratio - of old to young - be tentatively regarded as 1 : 1, which anyway, it almost is.

Table 14. Number and Ratio of Old to Young Baboons

Habitat Type	No. of Troops	No. of Animals		Ratio of Old to Young
		Old	Young	
A	2	31.27	34.72	1 : 1.11
B	2	21	19	1 : 0.9
C	1	13	9	1 : 0.69
D	1	13	15	1 : 1.15
E	3	49.22	42.78	1 : 0.87
Total	9	127.49	120.5	
Mean		14.17	13.39	
Overall Ratio				1 : 0.95

3-3.3 Ratio of Adult Females to Young

According to Rowell (1972) the successive proportions of adult female to juveniles give an indication of the rate at which the population is growing. Thus for example, she obtained a ratio of 1 : 3 in 1963 and for the same three troops a ratio of 1 : 2 in 1968 and she concluded (in 1972) that the population was growing less fast with time.

The ratio of adult females to immature baboons obtained in this study is given in table 15. The ratio varies from troop to troop and ranges from 1 : 1.20 to 1 : 2.25. In all cases, the immatures outnumber the adult females. The overall ratio is 1 adult female to 1.51 immature baboon.

Table 15. Ratio of Adult Females to Immature Baboons

Habitat Type	Troop No.	Adult Females	Immatures	Ratio
A	A1	14	21.72	1 : 1.55
A	A12	7	13	1 : 1.86
B	B1	4	9	1 : 2.25
B	B2	8	10	1 : 1.25
C	C1	7	9	1 : 1.29
D	D1	9	15	1 : 1.67
E	E1	11.78	16.78	1 : 1.42
E	E2	10	12	1 : 1.20
E	E3	9	14	1 : 1.56
Total		79.78	120.50	1 : 1.51

The higher proportions of immature baboons are as expected. Each adult female produces an average of two to

three young ones before the latter mature. They therefore outnumber their mothers. The future ratios of adult females to immatures should indicate the trend of population growth of baboons in the KLNP.

3-3.4 Current Reproductive Status of KLNP Baboon Populations

The most important demographic feature of any section of a population is its current reproductive status (Boughey, 1973). Ecologically there are three major age groups in a population as proposed by Bodenheimer (Kormondy, 1976). These are pre-reproductives, reproductives and post-reproductives which have become commonly used as an aid in visualising the status of a population.

The three reproductive categories dovetail and their definitions are certainly complicated by the social hierarchy of the baboons and the difficulty of determining exactly when a wild animal attains any of the three stages of sexual development. For this reason, only two age categories of baboons will be recognised in an attempt to compute the reproductive status of the animals. These are the reproductives (all adult animals) and the pre-reproductives (all immatures). The overall ratio of these two reproductive groups has been shown to be approximately 1 : 1. This ratio suggests that the baboon populations are neither expanding nor declining: they are stable.

3-4 BABOON POPULATIONS: COMPARISONS AND DISCUSSIONS

3-4.1 Troop Mean Size

Papio anubis populations occur in many parts of Africa. They vary in size and in many other population parameters from one region to the other.

The accompanying table 16 shows the variations found in olive baboon troop size in the major areas of Africa where it has been studied. Jolly (1972) has reported that such variation is common in primate species that have been studied and she attributes the situation to scantiness and inadequacy of data as collected by various observers.

The variations might be due to differences in habitat and the attendant social organisations of the troops. Also, counting bias cannot be ruled out as contributing to the reported variations in troop size.

Table 16. Records of Troop Size of Papio anubis

Group Size		No. of Groups Counted	Study Area	Observer(s) and Year	Source of Data
Mean	Range				
25*	16-40	?	Uganda	Lumsden 1951	Lumsden 1951
43	10-200	?	Kenya	De Vore 1959	De Vore 1963
41	12-87	9	Kenya	De Vore 1959	De Vore 1965
88.89	61-?	9	Kenya	Strum 1960	Strum 1975
42	27-76	8	Kenya	De Vore 1963	De Vore 1965
35	30-45	3	Uganda	Rowell 1963	Rowell 1972
40.33	29-47	3	Uganda	Rowell 1964	Rowell 1969
17.3	2-49	30	Ethiopia	Crook/Blake 1965	Crook/Blake 1968
6.5	?	?	Nigeria	Henshaw/ Ayeni 1971	Henshaw & Ayeni 1971
33.15	18-43	32	Nigeria	Abolude 1977	This Study

Note: ? = Not given

* = Mean calculated by Hall (1962a)

While it would be unwise to generalise on the limited data presented here, this study shows no correlation of group size with habitat types as defined. This is not to say that

none exists but it would require a different view of habitat, perhaps emphasising the variety in the habitat for baboons, in order to reflect it.

The study does show a correlation between troop size and the occurrence of permanent water, and while this may be part only of the story, the correlation is clearly positive and seems important.

3-4.2 Regional Variation in Sex Ratio of Adult Olive Baboon

Like its group size, the adult sex ratio of the olive baboon varies regionally. The adult male to female ratio varies from 1 : 1 (Rowell, 1969) through 1 : 2.05 Crook and Aldrich-Blake, 1968) to an incredible 1 : 10 (Hall, 1962a). The ratio resulting from this study is 1 : 1.67.

The occurrence of baboon groups with more adult males than females is rare, and as far as I know up till the time of writing this report, this type of observation has been recorded once only for olive baboons by Rowell (1964) while Altmann and Altmann (1970) alone have reported a similar situation in the yellow baboons.

It is difficult to understand why this unequal adult sex ratio, almost always in favour of the females, should exist in the baboons. Altmann and Altmann (1970) have suggested that there may be systematic differences in sex at birth. This is possible but is not likely, as they (1970) have concluded on the basis of records of studies on other primates. In fact, their own limited data on this matter of major sex differences at birth point away from the generally observed direction - seven babies born in the course of their field work consisted of six males and one female instead of the other way round. This situation was perhaps responsible for their rare observation of troops with more males than females.

The keeping of birth records of baboons under observation might throw some light on differential birth as it affects adult sex ratio. The task is difficult because the sex of baboon infants is not easy to determine in the field. Some form of captivity might be necessary to have reliable records of systematic differences in sex in new-born baboons. Until this is done the existence of sex disparity at birth will remain largely speculative and this will make it impossible to relate adult disparate sex ratio to major sex differences at birth.

The occurrence of adult male isolates may contribute to the situation whereby the adult males are almost always outnumbered by their female counterparts. However, male solitariness invariably ultimately ends in transfer to another group. Its permanence is rare. Hence the differential rate of inter-group migration cannot satisfactorily account for sex-ratio disparity.

A third factor widely suggested for trying to explain the disparity in sex ratio is differential mortality. De Vore and Hall, (1965) have ruled out this possibility. Poachers usually go for adult males because of their large size. On the other hand leopards which are the baboons' chief carnivorous predator have been reported to avoid adult males and select adult females instead (Bramblett, 1969). Where poachers and leopards prey on baboons, the activities of both will probably even out the proportions of male and female mortality. Male baboons are reported to suffer low natural mortality. Thus for example a study period of five years by Rowell (1969) recorded only one adult male death. Hence differential natural mortality falls short of satisfactorily accounting for the disparate adult sex ratio.

De Vore and Hall (1965) have attributed disparate sex ratio in adult baboons to the fact that females mature in roughly half the time that males do. This implies that female baboons are counted as adults whilst their male counterparts are still regarded and counted as juveniles.

Two factors seem to satisfactorily account for unequal number of male and female adult baboons in the KLNP. The first is differential predation. Baboons here apparently face no threat from their few felid predators. Their chief enemy is man and he favours the bulky adult males as his target. This reduces the number of adult males. In the absence of any similar predation on the adult females, they should as they do, outnumber the males. The second factor is differential rate of maturation as suggested by De Vore and Hall (1965). The effect of this is that the observer, as a result of the bias and limitation, tends to undercount male counterparts of adult females. This bias may indicate the limitation of age criterion for counting baboons.

3-4.3 Population Data: Comparison with Other Studies in the KLNP.

While the reported variations that occur in baboon populations from area to area in Africa and within the Nigerian ecosystem can be explained on ecological grounds, other

explanations are needed to account for disparity of estimates by different observers working in the same study area. Table 17 shows the results of baboon population counts conducted in the KLNP by different observers.

Table 17. Baboon Population Estimate in the KLNP as Reported by Different Observers

Group Size		No. of Groups Counted	Total Population	Observer and Year	Source of Data
Mean	Range				
?	?	?	1,462	Brown 1967	Brown 1967
?	?	?	1,500-2,000	Howell 1968	Howell 1968b
20	<20->50	?	8,019	Child 1970/ 1971	Child 1974
20	<20->50	?	11,728	Child 1971 1972	Child 1974
?	?	?	70	Milligan 1976	Milligan 1976
16.6	?	17	?	Ayeni 1977a	Ayeni 1977a
33.15	18-43	32	5,734	Abolude 1977	This Study

Note: ? = Not given

The population estimates for 1967 (Brown) and 1968 (Howell) are nearly the same. Child's 1971/72 figure of 11,728 has been described by him (1974) as probably high and he considers his 1970/71 estimate of 8,019 nearer the truepopulation of the baboons in the Park. Milligan (1976) whose aerial survey (in my opinion a totally inappropriate technique for counting baboons) recorded a total of 70 baboons regards his own estimate as "imprecise". Ayeni (1977a) does not give an estimate of the total population of the KLNP baboon. This study puts it at 5,734 baboons.

Assuming that the nearly equal estimates of 1967 and 1968 were accurate then, the baboon overall population should increase with time since according to Howell (1969) the population was "steadily increasing". This view has been corroborated by estimates produced by both Child's 1970/71 study and this one, although the figures differ. The reasons that probably explain the difference in the two estimates are:

1. time lapse between 1971 and 1977 observations
2. differences in census methods
3. differences in sampling methods
4. differential acuity of observers and
5. baboon group behaviour which could vary with season and time.

An interval of six years is capable of witnessing changes in the population figure of an animal, either favourably or otherwise. There was no evidence (e.g. skeletal remains) of natural mortality on baboons in the Park between 1971 and 1977. The baboon is not a favourite target of poachers coming into the KLNP. Bigger animals like the Western hartebeest Alcelaphus buselaphus and roan antelope, Hippotragus equinus are the worst-hit victims for their meat while the elephant, Loxodonta africana is hunted mostly for its tusks. Be that as it may, poachers do kill baboons and 33 baboon heads were seized by the KLNP Management in the course of this investigation. In view of the low natural mortality in baboons and in spite of the menace of poachers, it is not felt that mortality on baboons between 1971 and 1977 could satisfactorily explain a difference of 2,285 animals found in the two estimates.

Therefore, the view is strongly held that the disparate population figures for 1971 as obtained by Child (1974) and for 1977 as produced by this study are due mainly to differing methodology and individual bias in counting. Variations in the behaviour of the baboons must have also contributed to the situation, though such a contribution is not likely to be significant. The importance of differing methodology in producing disparate census figures is underscored

by Milligan's (1976) aerial census which put the baboon population in the Park at 70 animals.

It might be tentatively suggested that the population of the KLNP baboon is in the region of 5,734 animals as computed in this report and 8,019 as reported by Child (1974).

3-5.1 Solitary Baboons

The literature gives many instances of baboon isolates, usually adult males. According to Crook (1970), an adult male that falls in social status, becoming peripheral, may opt out of its group and become solitary. A solitary baboon is most likely to be in the process of transferring from its group to another since such solitariness is usually temporary.

In the course of this study we encountered three adult male isolates. Two of these were seen in the Acacia habitat while the third was found in the Burkea-Terminalia habitat.

The behaviour of the three solitary adult male baboons was remarkably identical. Each tried to get away from us rather hastily and without the slightest barking.

Our efforts to follow them over some distance continued to evoke the same behaviour from them. Their cautious attempts to evade us must have arisen from their fear of the team being possible poachers. As for the absence of barking so characteristic of adult male baboons within groups, it is suggested that barking is a means of vocal communication not only to locate one another but also to warn themselves of any possible danger around. It is therefore almost non-existent in solitary baboons.

3-5.2 Sick Baboon

During this investigation, only one apparently sick baboon was sighted, in habitat type A. It was an adult male, looked emaciated and could pass easily for female rather than the usually bulky male baboon. Baboons are generally reported not to care for or worry about sick members (Washburn and De Vore, 1961). Our experience with this seemingly sick baboon did not confirm this view. We in fact, witnessed an interesting episode involving the baboon.

When most members of its group had crossed the road, the sick baboon was still on the other side. We then interposed ourselves between it and the rest of the group. Shortly after, four male adults crossed back the road

on our southern side and some three minutes later they crossed again rather hastily from our northern side and back to the rest of the group. But this last crossing was done by five, not the original four, adult males. Apparently they had gone back to fetch the sick baboon and to guard it to safety. By chance or coincidence, but could as well be on purpose, the sick baboon was placed third in the middle of the file. Perhaps no greater display of care could be expected from a non-human primate.

3-5.3 Sick Olive Baboon or A Hybrid or Another Species?

We once sighted an unusual adult male baboon. It was lighter in fur colour than anything we had ever seen in any baboon in the Park. Its face looked more dog-like than the typical olive baboon in its troop.

In view of the fact that baboon species are known to co-exist and to have hybrids, it is quite possible that the unusual baboon which we saw was another species of baboon or a hybrid of olive and another baboon species. This speculation is to be treated with caution until a competent taxonomist comes to the scene, although we certainly saw a baboon that looked remarkably different from the olive baboon we are used to in the Park.

3-6.1 Digest of Population Data Based on This Study

In sum the population we encountered consist of 32 baboon troops numbering 859 animals. The weighted mean troop size is 33.15 animals (S.D. = 4.62; S.E. = $\pm$2.07). The nine troops that were thoroughly censused contain 248 animals (mean 27.56 : S.D. = 7.70; S.E. = $\pm$2.57) and are made up of 1.14 per cent babies, 8.2 per cent infants, 39.25 per cent juveniles, 32.17 per cent adult females, 6.85 per cent sub-adult males and 12.38 per cent adult males. The overall population computed from the data is of the order of 5,734 baboons in the KLNP.

CHAPTER 4

DAY-RANGE AND HOME-RANGE

CHAPTER 4

D A Y - R A N G E A N D H O M E - R A N G E

4-1 STUDY METHOD

Having randomly selected the four troops that were to be closely studied as detailed under "Basic Methodology of Study", a day-range map of the sampling unit occupied by each was prepared. For this exercise, we used Geerling's (1976) and Child's (1974) Maps as well as the personal knowledge of the author and his assistants.

Each day-range map was divided into 100 squares, and each square corresponds to approximately 0.045 km. x 0.045 km. on land. Each square was roughly demarcated on land and identified by means of natural land-marks, the most important of which were water courses, plant associations, termitaria and rock outcrops. Use was made also of the roads in the Park and of experimental sites there. The day-range maps were then reproduced in bulk.

From dawn till dusk, depending on when the troop concerned descended and later ascended its lodge tree complex, we followed the animals on foot. We did this close enough to them without interfering with any of their activities. The distance covered each day was measured using two pedometers simultaneously. By means of the day-range map and a marching field compass the route of the day-journey was plotted on the appropriate grid square. Hourly progressions were noted.

The small size of the grid squares was considered adequate to ensure that possible errors in route-mapping did not exaggerate the actual size of the area traversed by a troop. In addition we avoided diversions as much as possible bearing in mind Hall's (1965a) warning that pedometers are limited in value due to observer diversions arising from terrain differences in the field. In spite of their limitations, however, we found the pedometers less clumsy than and perhaps more accurate than camera range finders. It appears that this technological aid improves the accuracy of pacing used by Caro (1976) in his determination of the range of the gorilla. Pace counting was found to distract our attention on note-taking and had to be quickly abandoned. The pedometers were left to do the counting and reckoning of distance and this left us with enough time for other observations.

Determination of travel patterns by plotting and then connecting points as we did by means of lines is necessarily conservative. The travel estimates obtained fail to reflect departures which occur frequently from the most direct route (Mason, 1968). Our distance estimates are made even more conservative by the fact that we could only trail the path taken by the rear party of a troop. To do otherwise would certainly have interfered with the behaviour of the animals under observation.

Mason (1968) has called for a distinction between path length (total travel, regardless of direction) and travel distance (the straight-line distance between the two most remote points in a day's travel). From these definitions

by him, it is obvious that what we measured is the more precise path-length. Since we are interested in distance and route, determination of travel patterns by estimating travel distance becomes unsatisfactory and will certainly under-estimate distance covered. Animals do not travel in straight lines as it assumes. Hence we determined the path length and direction simultaneously.

4-2 RESULTS

4-2.1 Tolerance distance

Initially, all the troops protested our presence once it was realised that it was not for casual observations. Grunting, barking and alertness were common-place. The distance at which the troops tolerated our presence then was about 40 - 50 metres. As time went on and habituation progressed, there was much less barking at being observed and the tolerance distance was at times as low as 30 metres.

Our proximity each day to any troop was determined by its vocal behaviour. Repeated grunts were indicative of our pressing almost too near the troop while loud barks usually meant that we were intruding too much. Failure to take vocal warnings often prompted the animals to rush away from us. The tolerance-line varied from group to group and within the same group from time to time. However, this was generally within the limits of 30 to 50 metres.

The two groups with infants were the least tolerant of our nearness. In fact, the nursing mothers kept out of our view as much as vegetation would allow and their distance from the rest of the group could still keep them safe. We regard this behaviour of the troop and especially the nursing mothers as a protective instinct for the safety of their infants/babies.

4-2.2 Animals Determining Foraging Direction

Some controversy rages about which set or sex of animals determines the daily route which a troop will traverse. Kummer (1971) states that the direction is determined almost exclusively by the adult males while Rowell (1972) asserts that the older females determine it. Hall and De Vore (1965) have suggested that adult females that lead the group might be merely taking a course habitual to the group without necessarily determining the direction. Kummer (1971) suggests a compromise; while asserting that the males choose the direction, he goes on to say that "the actual route is the result of compromise by several adults".

Out of the 119 day-journeys observed, the directions in 97 cases were decisively led by the adult males; the adult females led the troops on 18 such journeys while the remaining four journeys were mutually directed by a mixture of

adults of both sexes. Our data suggest that males determine the foraging direction much more than do females and that the immatures have no say in the matter.

4-2.3 Foraging Period

Baboons are strictly diurnal. They will descend the lodge-trees in the morning only when day-light permits clear visibility. Ascent on to lodge trees takes place before it gets too dark to see. Nothing will probably succeed in dislodging them from lodge trees in the course of the night: except perhaps an armed man from whom they might escape only by running.

Between April 1, and June 20, 1977, the Study Area was generally under the influence of medium photoperiod of about equal day and night lengths. Photoperiod is taken to be the hours of daylight as influenced by both season and local cloudiness, and is not necessarily the time between sunrise and sunset. During this photoperiod, the troops, from a total of 63 journeys, generally descended their lodge trees around 7.00 a.m. and later in the day ascended the same or new ones by about 6.20 p.m. Invariably, the juveniles and the sub-adult males were the first to come down. As soon as they did, they would look for available food items and drinking water where available. Some 20 minutes later the whole troop would have descended and before we realised it the day-journey would have started.

During the medium photoperiod - disregarding a heavily-raining day in which one troop moved for only 4.52 hours - the four troops spent between 5.78 and 7.72 hours (n = 62)

on its daily journey. The length of time spent on the move varied to some extent on when the last animal, usually an adult male, of the troop descended: since it was then that movement would commence.

As from the 21st June onwards, we entered into a phase of longer photoperiod. By as early as 5.30 a.m. the day would have become bright enough and the troops would have descended from the night's lodge-trees. In fact on the morning of 21st June, it was the barking of some baboons near the door-step of the camp that roused us from our sleep at about 5.45 a.m. They must have covered about a half kilometre from their traditional lodge-trees in order to arrive at our camp.

During the period of longer photoperiod the length of time spent moving was between 6.62 and 10.07 hours. The effect of this on distance covered will be discussed later.

4-3 DAY RANGE

4-3.1 Foraging Distance

Troop I of 43 animals moved an overall mean of 5.32 km. per day for 29 non-consecutive days. The distance covered in a day vary from an unusual 1.60 to 6.40 km. The mean day-range during the dry period was 5.23 km. while it

was 5.35 km. in the wet period. In this and subsequent discussions dry period means, unless otherwise stated, the period of investigation - 1st April to 1st May inclusive - during which no significant rain had fallen. Wet period, on the other hand is the period of rain from 2nd May until the last day of data collection which was 30th September.

Troop II of 35 baboons progressed an overall daily mean of 4.33 km. This ranges from 2.56 to 5.60 km. per day. During the dry period the foraging distance was 4.19 km. per day while in the wet period it was 4.36 km./day.

Troop III containing 28 baboons did an overall daily distance of 3.45 km. and this ranges from 1.92 to 4.80 km./day. Dry period daily mean distance was 3.04 km. while it was 3.55 km. during the wet period.

Troop IV having 22 animals progressed an overall daily mean distance of 3.20 km., the range of which was 2.72 to 4.16 km./day. During the dry period the figure was 3.01 km./day while it was 3.25 km./day in the wet period.

The foraging distances in all four cases are given in table 18 which also contains the appropriate statistics i.e. standard deviations and standard errors.

Table 18. Seasonal and Overall Day-Range Distances

Troop Size	Habitat Type	Mean Day-Range in kilometres*		
		Dry Period	Wet Period	Over-all
43	A	5.23 [7] (0.24; ±0.09)	5.35 [22] (1.01; ±0.22)	5.32 [29] (0.55; ±0.10)
35	E	4.19 [6] (0.68; ±0.28)	4.36 [24] (0.70; ±0.14)	4.33 [30] (0.43; ±0.08)
28	D	3.04 [6] (0.23; ±0.09)	3.55 [24] (0.57; ±0.12)	3.45 [30] (0.35; ±0.20)
22	C	3.01 [6] (0.24; ±0.10)	3.25 [24] (0.35; ±0.07)	3.20 [30] (0.21; ±0.04)

LEGEND

* 1 km. = 0.625 mls.

[ ] Number of journeys

(;) Standard Deviation and Standard Error Respectively.

The results show that the larger the troop, the longer the average daily distance it covered.

The day-range figures obtained parallel those found in the literature for the olive baboon. Thus for example, Rowell (1972) reports that the Ugandan olive baboon does some

2 to 2.5 km. per day with a maximum of 6 km. while its Kenyan counterpart does some 5 to 6 km./day. The former lives in the forest while the latter lives in the savanna. This might suggest that habitat type determines day-range and our figures of between 3.20 to 5.32 which are intermediate between those reported above give weight to this view. The figures are intermediate just as the habitat, a wooded savanna, is intermediate in structure between the forest and the almost grassy savanna.

4-3.2 Day-Range in Relation to Troop Size

Table 18 shows that in all four cases, the day-range distance both on overall and on seasonal bases, varies directly with troop size. Thus the largest troop with 43 baboons covered an average distance of 5.32 km. per day while the smallest troop which consists of 22 animals did a daily average of 3.20 km. Hall (1962a) obtained a similar result within certain limits of large troop size.

Since this study has shown that the day-range distance covered is partly determined by troop size, the distance covered by numerically different troops cannot be a good index of the relative productivity of the habitats.

4-3.3 Effect of Lodge Tree Selection on Day-Range

If a baboon troop returned to its tree sleeping place of the previous night, the distance progressed was usually equal to that of the return journey. However, a change in the previous night's sleeping place led to variations in advance and return distances. When the new sleeping tree-complex is nearer to the limit of the day's forward progression than the previous night's complex, then the return distance necessarily becomes shorter than the advance one. This is because the animals must have chosen a complex nearer to the limit of the day's journey than was the one from which they descended in the morning. Conversely, if the lodge tree-complex for the night is more distant (from the end of the day's forward progression) than that that was used the previous night, then the return distance was necessarily longer than the advance distance.

The implication of the above observations is that the selection of the lodge tree-complex for the night either shortens or lengthens the distance of the day-range. Hall (1962) has statistically reported this to be significantly true for the chacma baboon.

4-3.4 Seasonal Variation in Day-range Distances

All four troops covered longer distances in the wet than in the dry season (recall table 18). However, the difference between wet and dry season distance is insignificant at 5 per cent level ($\chi^2 = 0.034$; $P > 0.05$; d.f. = 3). Altmann and Altmann (1970) made a similar observation on Papio cynocephalus and there may therefore be a real difference not statistically detected by the data I have.

Lack of statistical significance does not necessarily invalidate an observed empirical fact. Therefore some reasons could be suggested for the observed - though statistically insignificant - seasonal variations in day-range distances. The first is that relative scarcity of food in the dry season led to extensive and time-wasting tuber digging. This time-consuming feeding behaviour must have been partly responsible for the shorter distances covered in the dry period. Secondly, the generally hotter afternoons in the dry period necessitated more afternoon rests than obtained during the wet period. More rests mean less distance, all other things being equal. Thirdly, the onset of the rains made it possible for the baboons to get water almost anywhere and were therefore no longer tied to the vicinity of permanent water-holes as was the case in the dry period.

4-3.5 Photoperiodic Variations in Ranging Distances and Speed

Nigeria experiences three types of photoperiods. These are the medium, the shorter and the longer. The medium photoperiod is characterised by an almost equal night and day. The shorter photoperiod has less than 12 hours day-light per day while the longer photoperiod, its opposite is marked by more than 12 hours of day-light per day.

In the course of this study only the 'usual'(medium) and longer photoperiods were on in Nigeria. The second terminated the first on the 21st June, 1977 and remained until the investigation was wound up.

During the medium photoperiod, troops I to IV covered 5.11, 4.20, 3.33 and 3.07 km. respectively on daily average. The corresponding distances covered during the longer photoperiods of "longer days, shorter nights" were 5.55, 4.47, 3.58 and 3.35 km. per day. These facts are displayed in table 19. In all four instances, a troop travelled on average a longer distance in the longer than in the medium photoperiod.

Table 19. Day-Range Distances During 'Usual'(Medium) and Longer Photoperiods

Troop Size	Habitat Type	Mean Day-Range in kilometres*	
		Medium Photoperiod	Longer Photoperiod
43	A	5.11 [15] (1.00; ±0.26)	5.55 [14] (0.68; ±0.19)
35	E	4.20 [16] (0.57; ±0.143)	4.47 [14] (0.80; ±0.21)
28	D	3.33 [16] (0.32; ±0.08)	3.58 [14] (0.74; ±0.20)
22	C	3.07 [16] (0.23; ±0.06)	3.35 [14] (0.38; ±0.10)

LEGEND

* 1 km. = 0.625 mls.

[ ] Number of journeys

(;) Standard Deviation and Standard Error Respectively.

The explanation for the observed differences in day-range distances in relation to changes in photoperiods could be found easily enough in the amount of time available for foraging during each photoperiod. Whereas the four troops had maximum periods of 7.18, 7.28, 7.72 and 7.28 hours respectively during the medium photoperiod, these available times increased in all cases during the longer photoperiod to 10.07, 9.10, 9.85 and 9.80 hours respectively. The availability of more foraging hours is expected to result in longer distance coverage as happened in this case. However, it must be realised that other factors like seasonal changes, rainfall and changes in the availability of food, all contribute to the situation which is therefore not as simple as it has been presented here.

Be that as it may, these other factors are not considered as important as the variation in photoperiods and have perhaps even been compensated for by speed reduction during the days of longer photoperiods. The longer the photoperiod, the earlier the baboons start foraging and the much later they end the days journey. Therefore the farther they go, although the less the speed.

Table 20. Day-Range Speed Variation with Photoperiods

Troop Size	Habitat Type	Mean Speed in km/hr.		
		Medium Photoperiod	Longer Photoperiod	Overall
43	A	0.807 (0.13; ±0.04)	0.629 (0.06; ±0.02)	0.721 [29]
35	E	0.645 (0.10; ±0.03)	0.541 (0.07; ±0.02)	0.596 [30]
28	D	0.465 (0.04; ±0.01)	0.391 (0.15; ±0.04)	0.430 [30]
22	C	0.462 (0.04; ±0.01)	0.386 (0.05; ±0.01)	0.426 [30]

LEGEND: as in preceding table.

Table 20 gives the mean speeds at which the baboons travelled in different day lengths. It shows that there is a positive relationship between troop size and mean speed. This relationship is found regardless of the photoperiod type just as it is on overall basis. This result probably suggests that larger troop size demands speedier movement so that all the members of the troop might have enough food to meet their

energy requirements. It might also be that successful food searching ability varies from troop to troop and determines speed of movement.

The above table also shows that troop mean speed varies from one photoperiod to the other. In all four cases, the speed during the longer photoperiod is less than that during the medium photoperiod. However this relationship, just like that between photoperiodic changes and ranging distances, is certainly complicated by other environmental factors as listed under discussion on the latter relationship. None-the-less, the result shows that longer photoperiods are related to lower speed, and as already shown, this phenomenon does not result in decreased distance. This is because more hours are available during such longer photoperiods and this enables the troops to cover longer distances than during the medium photoperiod.

4-3.6 Effect of Rainfall on Day-Range

Like man, baboons are averse to walking in the rain, especially when it is heavy. However, it seems to us that if they had to defy the rain in order to obtain food, they probably would. For the reason that rainfall might affect baboon behaviour we took records of rainfall as it occurred in relation to each foraging troop.

Troop I with 29 day-journeys experienced 21 rainless and eight rainy days. Troop II scored 21 rainless and nine rainy days. Troop III had 18 rainless and 12 rainy days while troop IV foraged in 22 rainless and eight rainy days. In all the 119 day-journeys by the four troops were performed on 82 rainless and 37 rainy days.

Statistic t was used to determine the significance of rainfall on the distance covered by each troop. Table 21 shows the results and the inferences therefrom. The level of significance is 5 per cent.

Table 21. Statistical Significance of Rainfall on Length of Day-Range.

Troop	t Value	d.f.	P	Inference
I	1.91	27	$P > 0.05$	Insignificant Difference
II	1.10	28	$P > 0.05$	"
III	1.02	28	$P > 0.05$	"
IV	2.10	28	$P < 0.05$	Significant Difference
I - IV	1.44	117	$P > 0.05$	Insignificant Difference

The results show that overall and in the cases of troops I, II and III, rainfall although retarding progression, has no significant effect on the distance covered in a day. Troop IV the smallest in size with 22 animals, alone was significantly retarded in movement by rainfall. On the average, troop IV covered a significantly shorter distance on rainy than on rainless days, the values being 3.273 and 3.00 km. per day, respectively.

Troops I to III did not always seek shelter during a raining session. Their respective habitats were well foliated thereby affording them a large measure of protection from the rains. Hence they had no need to seek special shelter on trees whenever it was raining. Troop IV behaved true to expectations by taking refuge from the rains. The habitat of this troop, unlike those of the other three was open: the canopy was not continuously well-foliated. This necessitated seeking of shelter beneath or on few thickly-foliated trees in its habitat and it sacrificed some distance in the process.

Thus although rainfall does lessen the distance a troop covers in a day the effect might be or might not be significant depending on the canopy of the habitat.

4-3.7 Heavy Rain and Baboon Immobilisation

In all the four main troops foraged on 37 days of rainy spells. Eighteen of these were light/moderate while the remaining 19 were heavy/very heavy. Baboons are known to be immobilised by heavy as opposed to light to moderate rain.

Using the t-statistic to compare the effect of lightness or heaviness of rainfall on average distance covered by baboons of troop IV - the only troop whose day-range is significantly retarded by rainfall - it is discovered that this factor does not significantly affect the extent to which rainfall shortens foraging distance ($t = 0.516$; $P > 0.05$; $d.f. = 6$). The troop had four days each of heavy and moderate rainfalls.

Considering all the four troops, the shortest distances were recorded on two days of very heavy rainfall and stormy weather. These were 1.60 and 1.92 km.

The results of these t-tests show that although the baboons often take refuge in the course of heavy spells of rain (Crook and Aldrich-Blake, 1968; Kummer, 1971) they might not be completely immobilised at such times providing the habitat is generally with a high good canopy. This implies

that rainfall, heavy or moderate may not significantly affect the distance covered by a troop depending on the habitat's canopy. Of greater importance is, it would seem, the availability of food at the point it starts raining. It seems reasonable to suggest that the need to gather food should override the possible immobilising effect of heavy rain even where the habitat does not have a widely distributed good canopy.

The importance of food availability in determining the immobilising effect of heavy rain on baboons is emphasised by the observed fact that immobilised troops were almost always taking refuge on fruiting trees. This behaviour looked deliberate rather than coincidental, and it ensured that the immobilised animals had fruits to eat.

4-3.8 Effect of Temperature on Day-Range

The time-budget of the baboons to be dealt with later show that the animals spend 20 per cent of their total time resting either by sitting or standing still. Of this activity the bulk, 52 per cent, occurs in the afternoons during the heat of the day.

If baboons rest as they do under tree shades when the day is hot, it stands to reason that the hotter the day,

the less the troop will move, all other things being equal. Hall (1962a) has in fact shown that the day-ranges of winter are significantly longer than those of summer for some baboon troops which he observed. He suggest that this seasonal variation could be due to the higher day-temperatures of summer, though perhaps more due to food dispersion.

The possible effect of day-temperature on the average daily distances covered by the main four troops has been statistically examined using the statistic correlation coefficient, r. The formula applied is the following given by Hayslett (1967):

$$r = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{\left[\sum x^2 - \frac{(\sum x)^2}{n}\right] \cdot \left[\sum y^2 - \frac{(\sum y)^2}{n}\right]}}$$

where x = one variable (temperature in this case)

y = second variable (distance in this case)

n = number of scores for either variable.

The results are displayed in table 22.

Table 22. Correlation between Temperature and Day-Range

Troop	Temperature Range: °C	Distance Ranged: km.	Correlation Coefficient, r	Inference
I	27 - 40	4.96 - 6.12	- 0.14	Negligible Negative Correlation
II	27 - 40	3.68 - 5.20	- 0.55	Weak Neg. Correlation
III	28 - 40	2.88 - 3.97	- 0.52	Weak Neg. Correlation
IV	31 - 41	2.88 - 3.56	- 0.69	Fairly High Negative Correlation

It is in the case of troop IV alone that there is a fairly high negative correlation between the day-temperature and the average day-range distance. Troops II and III show weak negative correlations. All these three troops indicate that the higher the day-temperature the less the average distance the troop covers in its day-ranging. The obvious reason for this is that higher temperatures are associated with shade-seeking and resting by baboons.

On the other hand, troop I alone shows a negligible negative correlation between day-range distance and high day-temperature. This anomalous behaviour could have arisen as a result of the capability of the habitat involved to provide shade in most places through which the troop had to pass. If this were so, there would be no necessity for the troop to specially seek out under-tree shades which it could have almost anywhere.

Although most of the baboon troops showed fairly high negative correlation coefficients between temperature and distance ranged, it is to be realised, as Miller (1975) has pointed out, that the significance of a correlation coefficient between variables is not necessarily an evidence for cause-and-effect relationship between them. Therefore, factors other than temperature might be involved in causing the observed relationship under consideration. Food is probably the most important in this respect, followed perhaps by an almost continuous shade which the vegetation of the habitat type is capable of providing for the animals in spite of the high day-temperatures.

4-4 HOME-RANGE

4-4.1 Definition of Key Terms

The home-range is the area which an animal individual or population habitually occupies throughout its adult life. It excludes areas which the animal may temporarily occupy in the course of migration.

Territory is that area of the animal's home-range which is strongly defended against conspecifics.

Core-area - term first used by Kaufmann, 1962-(Jolly1972) signifies that part of the home-range which an animal uses more frequently than others. The core-areas of baboon troops contain sleeping sites, water, resting places and food sources (De Vore and Hall, 1965). The core-area is essentially monopolised by the occupants (Jewell, 1966).

Home ranges of adjacent baboon troops are commonly reported to overlap either slightly (Hall, 1963a) or extensively (Stoltz and Saayman, 1970). The core-area of a baboon group is almost always exclusive to it. Territoriality meaning a strong defence of spatial boundaries against conspecifics, is rare in baboon troops. The awareness of

territorial integrity in baboons has been reported by Buettner-Janusch (1965) while Hall (1965b) writes of the evidence of behaviour "that could best be described as territorial" in the yellow baboon. So far as is known, only Hamilton et al (1976) have systematically observed a strong defence of territorial boundaries by chacma baboon troops.

All the key-words - home range, territory, territoriality and core-area - will be used in the context of the definitions given them.

4-4.2 Determination of Home-Range

The home-range is a composite measure usually expressed as the area encompassed by multiple daily ranges in an animal's search for its basic requirements and survival. In mapping the day-ranges of the four main troops, we were marking also their home-ranges.

To determine the home-range of a troop, the maps of all the day-ranges are superimposed on a single gridded map. The area of the home-range was then measured by counting the squares that successive daily movements covered on the map. The method of super-imposition aims at simplicity

in that only the longest day-range distances along any cardinal point direction are traced out on the gridded home-range map. The tracing out of longest distances alone seems to overcome the problem of producing "a tangled ball of yarn" which according to Altmann and Altmann (1970) who used the term, raises the problems of drawing the home-range boundary.

Since the method of super-imposition as used here also shows areas not previously covered by the animals in any compass direction, it is considered no longer necessary to find cumulative totals of area increments.

The cumulative totals of daily ranges have been used to find home-range of animals by some authors, for example Altmann and Altmann (1970) and Caro (1976).

Another means of assessing home-range size is to join the outermost points at which baboons of a troop were seen. This approach tends to give an over-estimate because there are apparently unused areas which would be then included.

4-4.3 Result and Discussion

The accompanying figures 5 to 8 are the charts showing the extent of the home-range of each of the four troops. Table 23 shows the troop size and the corresponding home-range area.

Table 23. Troop Size in Relation to Home Range Size in the KLNP

Troop Size	Home Range (Sq. km.)
43	29
35	26
28	18
22	16

As pointed out earlier, this method of estimating home-range extent is conservative and tends to exaggerate the home area which each troop actually utilises. Thus a number of locations included in a troop's home range were never observed to be utilised by the animals. Such locations or areas have never-the-less been included because they are

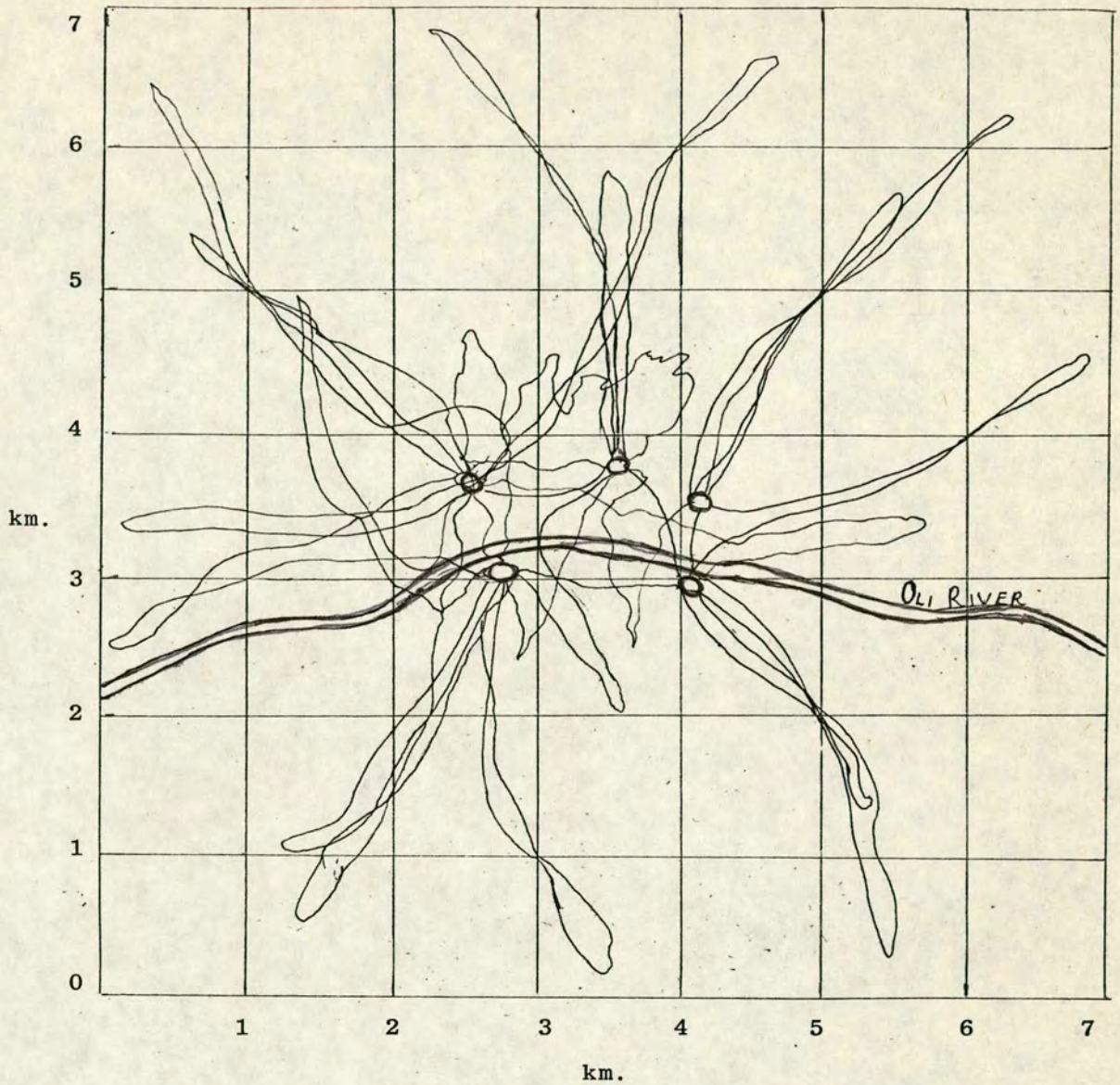


Figure 5. Home-Range Chart of Main Group I.
All the observed major pathways of the troop are shown. Extent 29 sq. km.

Legend

Route of Troop

Lodge Tree

1 Grid = 1 km^2

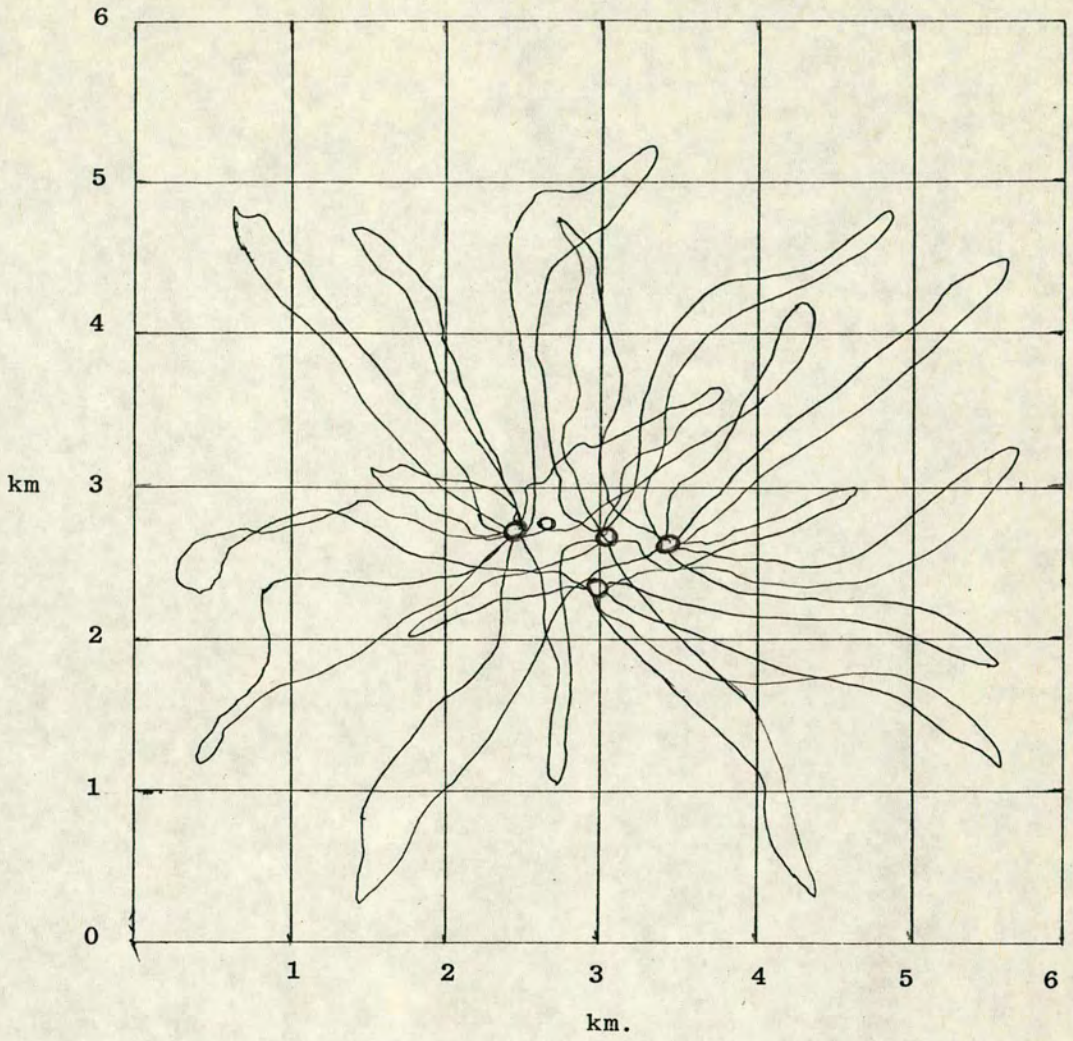


Figure 6. Home Range Chart of Main Group II. All the observed major pathways are shown. Extent = 26 sq. km.

Legend

Route of Troop

Lodge Tree

1 Grid = 1 km^2

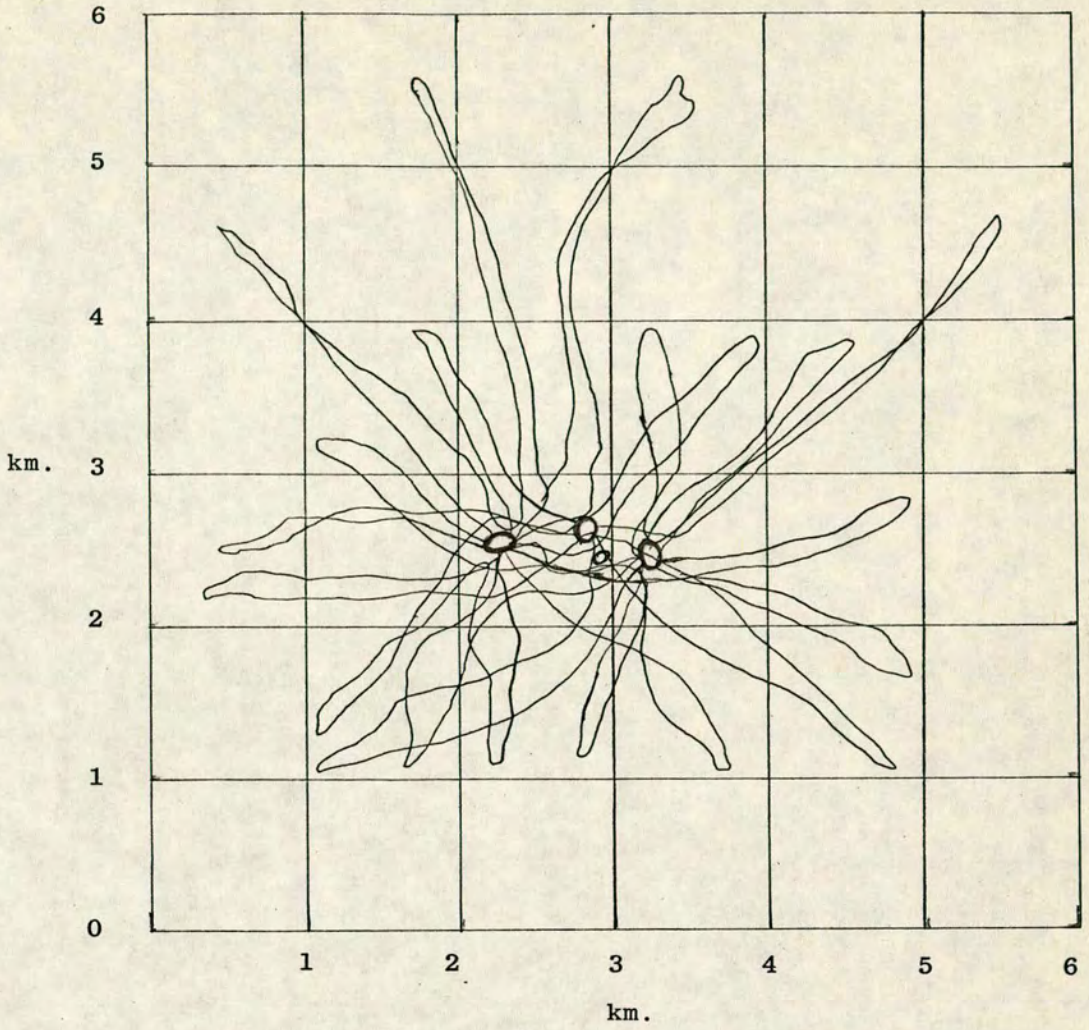


Figure 7. Home-Range Chart of Main Group III. Shows all the observed major pathways of the troop. Extent = 18 sq. km.

Legend

Route of Troop

Lodge Tree

1 Grid = 1 km^2

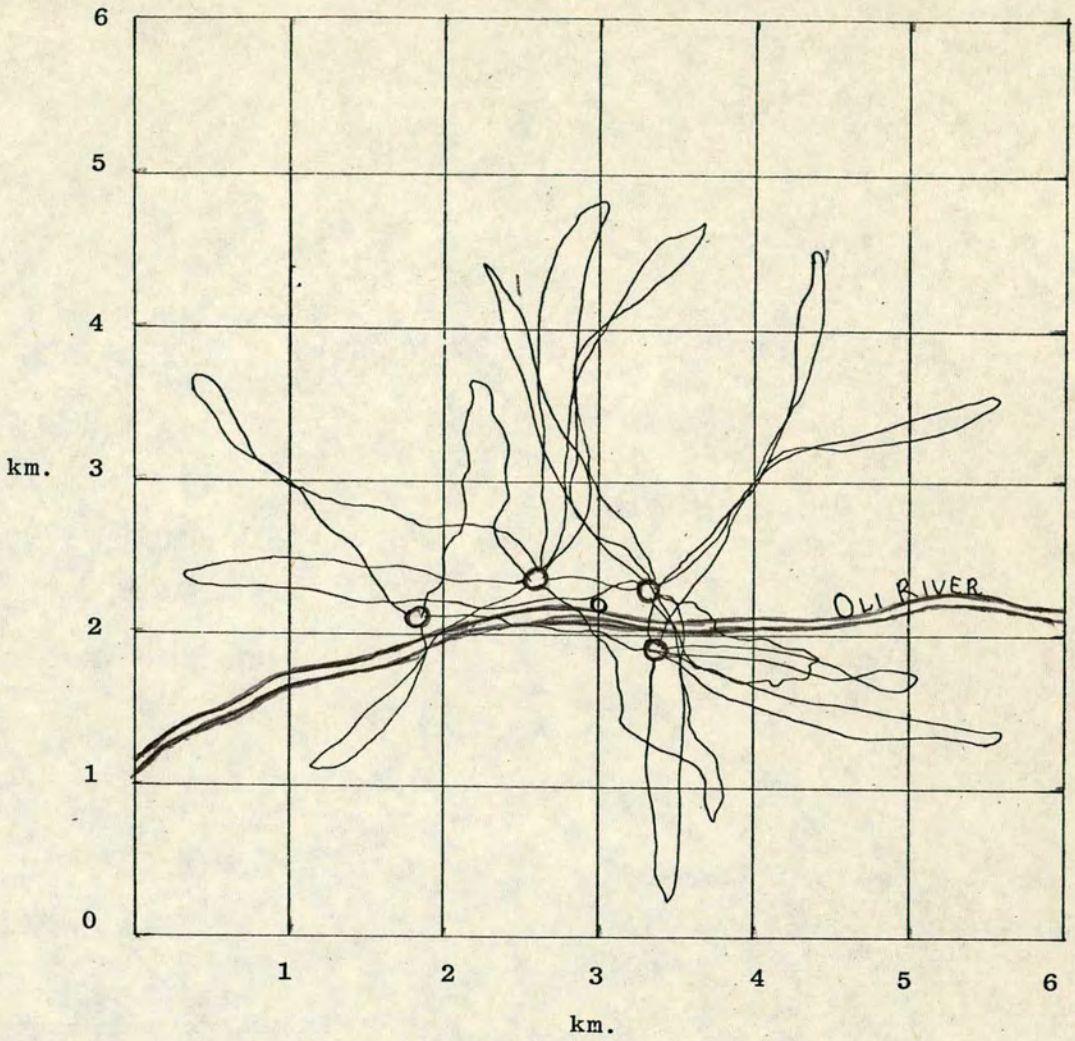


Figure 8. Home-Range Chart of Main Group IV. All the observed major pathways of the troop are shown. Extent = 16 sq. km.

Legend

Route of Troop

Lodge Tree

1 Grid = 1 km^2

enclosed within the utilised areas and are therefore potentially available for use by the troop. In fact such unused areas might be utilised later and are essentially and technically part of the troop's home-range. This phenomenon is commonplace as animals generally show differential utilisation or occupation of the home-range (Hayne, 1949b). Caro (1976) has observed male gorillas behave the same way and Rowell (1972) obtained similar results with Ugandan olive baboons.

The results show that home-range size varies directly with troop size. In order to test the statistical significance of this relationship, the correlation coefficient, r, has been determined using the following formula provided by Hayslett (1967):

$$r = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{\left[\sum x^2 - \frac{(\sum x)^2}{n}\right] \cdot \left[\sum y^2 - \frac{(\sum y)^2}{n}\right]}}$$

where x = troop size

y = home-range size

n = number of troops

The resultant correlation coefficient r, is 0.97. This reflects a high positive correlation between troop size and home-range extent. The meaning of this is that the bigger the troop size the more extensive its home range. This positive linear relationship is shown in figure 9, a scattergram.

4-4.4 Regional Variations in Home-Range Extent of Olive Baboon

The extent of home-range occupied by various-sized olive baboon groups in the different areas of its distribution shows that it varies regionally and locally. Table 24 has been prepared from literature sources to illustrate this point.

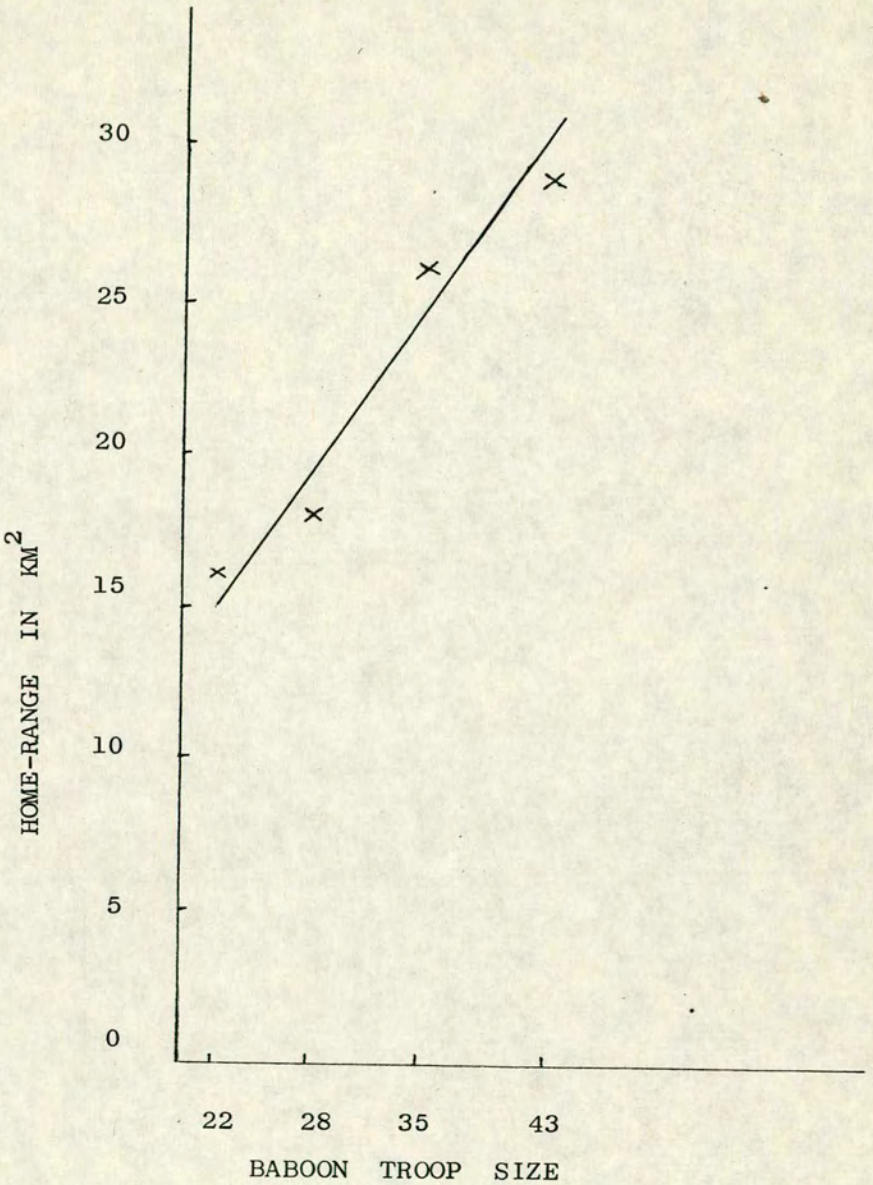


Figure 9. Scattergram of Correlation Between Troop Size and Extent of Home Range. The relationship is positive and linear ($r = 0.97$).

Table 24. Literature-based Reports of Home-Range Extent of Papio anubis Groups

Study Area	Vegetation Type	Home-Range (in sq km*)	Group Size	Authority
Kenya (Nairobi)	Grass Savanna	38.88	12-87	De Vore, 1963
"	"	18.14	24	De Vore & Hall 1965
"	"	7.78	28	"
"	"	40.18	28	"
"	"	24.88	40	"
Uganda (Ishasha)	Forest	4-7	29-74	Rowell, 1972
Kenya	Grass Savanna	38.88	65	Strum, 1975
Nigeria (Kainji)	Wooded Savanna	16-29	22-43	This Study

* 1 sq. ml. = 2.592 sq. km.

4-4.5 Factors Likely to Determine Home Range Extent and its Local or Regional Variations

Since the size of the home-range depends directly on the distance and direction of multiple day-ranges, any factors that may affect the latter necessarily determine the former. The following discussion highlights the most important of such factors.

4-4.5.1 Troop Size

The results of this study show that the larger the troop size, the wider its home range ($r = 0.97$). On the other hand, some Kenyan olive baboon troops indicate that the extent of the home-range might not vary directly with the troop size. Thus for example two troops each with 28 animals had 7.78 and 40.18 sq. km. home-ranges respectively while a troop of 40 animals has a home-range area of 24.88 sq. km. (vide: table 24).

Although troop size does not operate in isolation it would seem that the larger it is, all other factors being equal, the more extensive the home-range is likely to be as our results show. However, although this may be the case it is not always so (Clutton-Brock and Harvey, 1977b).

4-4.5.2 Habitat Type and Extent of Preferred Habitat

The grass savanna is more arid than the wooded savanna which is in turn more arid than the rich rain forest. The richer an area is in terms of flora, the less area an animal would cover to satisfy its energy requirements. This may in part explain why the grass savanna Kenyan olive baboons have larger home areas than the wooded savanna Nigerian ones which in turn occupy more extensive home areas than their rain forest counterparts in Uganda. The variation in habitat structure is of course interwoven with food resources in producing any effect on the size of the home-range. Local variations in extents of home-areas could also be connected with habitat openness. The farther the animals are able to see, the greater the tendency for larger home-areas and vice versa.

It is common knowledge that in any area, animals whose ranges include a large proportion of restricted preferred sections would tend to have much less home-ranges than those which do not select. This generalisation has been reported to hold true for primate groups (Clutton-Brock and Harvey, 1977b). The olive baboon groups are not likely to be an exception to this rule.

Other factors of environment that have already been shown to affect day-ranges correspondingly affect the size of the home-ranges.

4-4.5.3 Feeding and Food Dispersion

Feeding behaviour, the availability and dispersion of food items are all aspects of an important determinant of a group's home-area. Where the food items are clumped, range length and size will be small. This is because the group would not have to move from one distant area to another in order to meet its energy needs. On the contrary scattered dispersion of food would involve the group in longer day-ranges and therefore in larger home-areas.

Successful food searching ability of a troop is another important facet of food as a determinant of extent of home-range. The more efficient a group is in searching for food, the less area it would cover to find its fill. However, this aspect of animal feeding behaviour basically depends on the availability of food resources.

McNab (1963) has pointed out that the need for more food to meet the energy requirements of an animal will necessitate its covering a large area for food gathering, providing the food does not exist is superabundance. So important is the influence of food dispersion in determining the extent of the home-range that Clutton-Brock and Harvey (1977a) have stated that clumped food distribution may cope with increased troop size without affecting range-length. This suggests that food distribution could be more limiting in determining the extent of home-area than does troop size.

4-4.5.4 Water Availability

Baboons are fond of concentrating along river-banks in areas where water distribution is limited. Troops I and IV showed this behaviour but moved from the vicinity of permanent water as soon as rain pools formed here and there in their habitats. This movement occured at the onset of rains before any significant changes in food availability could occur. Therefore, the behaviour was not likely to be directly connected with vegetational changes.

The result of the formation of scattered rain water pools was that the baboons started using new sleeping trees removed from the immediate vicinity of permanent water. This enabled the animals to go farther away from permanent water holes and to cover new grounds. The implication of this is that the animals started to use previously untouched areas of the home-range thereby directly increasing its size.

4-4.5.5 Proximity of Neighbouring Troops

In the course of this study, no single case of inter-troop encounter reported by Deag (1973) to be common in Barbary macaque, Macaca sylvanus L, was in evidence. This might suggest that the baboon troops were not lying close enough to one another for such encounters to occur.

Alternatively it might be that although baboon home-ranges may overlap, it would seem that baboon troops choose their daily routes with some consideration for adjacent troops. Thus we observed that two adjacent troops almost always went to opposite foraging directions. Similar observations by Hall (1963a) have led him to postulate that adjacent baboon troops deliberately avoid contacting each other and that this implies that baboons are vigilant about movements and whereabouts of their neighbours.

In fact, encounters between baboon troops are rare (Rowell, 1972). This avoidance behaviour would limit the extent of the home-areas of two or more adjacent troops and it probably forms the basis of the existence of core-areas commonly observed within the home-areas of baboon groups.

4-4.5.6 Proximity of Predators and Other Animals

Apart from meeting its basic needs, an animal also has to avoid its enemies in its habitat. In the case of baboons, their most important enemies are their predators. In areas where the baboons are not protected, man may become a vital enemy to them.

A baboon troop would avoid areas where its enemies are concentrated, particularly where such enemies are

territorial and not nomadic. By cutting down the extent of its foraging area in order to avoid its enemies, a baboon troop or any other animal for that matter is necessarily regulating the size of its home range. The more such "danger zones" to avoid, the less the size of the home-area will become.

There is overlapping utilisation of food resources by the baboons and elephants of the KLNP. Since there is evidence that competition affects home-range size (Clutton-Brock and Harvey, 1977b) it is likely that the elephants from whom the baboons were observed to be running away would contribute to limiting areas which the baboons might otherwise utilise.

CHAPTER 5

FEEDING ECOLOGY OF AND CROP-RAIDING BY BABOONS

CHAPTER 5

FEEDING ECOLOGY OF AND CROP-RAIDING BY BABOONS

5-1 FEEDING ECOLOGY

5-1.1 FOOD

5-1.2 Motives for Studying Feeding Ecology

One reason for studying the food-habits of baboons is management-oriented. It is meant to provide useful information on the principal food items of the species as a means of managing them in the KLNP. The other reason is to try to deduce why baboons have established themselves as crop marauders and to offer suggestions for minimising this problem of crop-raiding.

5-1.3 Literature Digest on Feeding Behaviour of Baboons

Literature indicates that baboons eat almost anything that their hands and mouth can handle. Although omnivorous, the baboons are more vegetarian than carnivorous. Their reported eclectic diets include nearly all forms of plants in their environment and they utilise both aerial and sub-terranean items. They are reputed to be very fond of insects

like termites and grasshoppers for example as a source of animal protein. They are known to prey on small mammals which they are capable of hunting systematically (Strum, 1975; Lewin, 1976).

The more spectacular aspects of their feeding habits as reported in literature will now be briefly outlined. Some baboon troops observed by Marais (1939) exhibited changes in feeding habit. Initially they killed lamb for its milk only but they not only later killed it for its flesh, they started killing also sheep, fowls, guinea-fowls and turkeys. Marais (1969) has reported also how baboons skilfully manipulate the hard-shelled fruit of boobals, Adansonia digitata. Baboons turn over stones for scorpions tearing off the arachnid sting with lightning-like rapidity (Stevenson-Hamilton, 1947). Also remarkable is the dramatic way in which the baboons are reported (Crook and Aldrich-Blake, 1968) to manipulate and eat the spiny prickly pear, the Opuntia.

Baboons eat shell-fish, crab and damp clay (Hall, 1961) in South Africa as they do the last-named item in Nigeria (Ayeni, 1972). Goodall (1971) observed baboons eating hard palm-nut kernels and baked insects. Reports of bird-egg eating by baboons are common and Colt (1968) has warned that the Nile crocodile in Uganda faces extinction as a result of nest raids principally by baboons for its eggs.

Bere (1962) summarises the literature view of the feeding habits of baboons in concise terms: "baboons eat anything which comes their way" and credence is lent to this view by De Vore and Hall (1965) who state inter alia, "it is almost easier to list the items which they (baboons) do not eat than to describe the items which they do".

The adoption of literature-reported dietary eclectism and adaptability by baboons has one major advantage. This is, as Strum (1975) has observed, that during bad times when all other species of wildlife emaciate, the baboons could maintain themselves.

5-1.4 Feeding-habits Study Method

Two complimentary methods were used for studying the feeding habits of the baboons. These were:

1. Direct Observation and
2. Faecal Examination, not Analysis.

A third possible method is the examination and/or analysis of stomach contents. This was not attempted for the following reasons:

(i) trapping or shooting in the KLNP is outlawed

(ii) killing would certainly interfere with our observations of the behaviour of the baboons and our nearness would no longer be tolerated

(iii) the exercise would be time-consuming without necessarily significantly affecting the quality of the data obtained by a combination of the two methods used.

The method of direct observations where possible is certainly the best one for studying the feeding behaviour of animals. It not only shows what the animals feed on it also shows how the animals manipulate the items being utilised. Direct observations could be made by either of two methods. One is to select an individual and record its feeding activities continuously and the other, at intervals. These two approaches to direct observations of feeding have been called "focal animal observation" and "scanning" respectively (Clutton-Brock, 1977b).

Scanning is certainly less biased than its alternative, focal animal observation. In the first place, it enables the observer to cover many individuals thereby allowing for individual tastes of the animals, that is, it measures the average for the group. This makes it possible to analyse the data statistically. Secondly, considering age, sex and temperamental variations in a group, the selection of

one animal may not be as easy as it sounds. Finally, it is certainly much easier to lose track of an individual than the troop as a unit. If the observed animal is lost sight of or preyed upon, data collection automatically terminates. For these reasons, we selected direct observations of feeding through scanning.

5-1.4.1 Procedure

5-1.4.2 Direct Observation of Feeding Habits

The investigating team followed the four troops of concentrated study on foot from dawn till dusk when the animals are on the move. Since it was not possible to observe all the animals at a time and for the reasons mentioned earlier, we scanned the animals. Low visibility caused by flushing grasses, coupled with the spreading habits of the troop on foraging move made it possible to observe only about one-third of the animals at a scanning.

Observations were shifted from one party of a troop to another. A party is a foraging sub-unit of a troop. For instance our largest troop of 43 animals might break into four small parties each of which could be about 100

metres from its nearest neighbour. This constant shifting of attention on various foraging parties made us cover more individuals than would otherwise have been possible. In addition we recorded observations on occasions when the parties came together, covering as many individuals of the group as possible at one scanning.

As stated earlier in another section of this thesis, the distance at which the four troops tolerated our presence varied considerably from one to the other and was not constant for even the same troop. On the average tolerance was within limits of 50 metres. Growing grasses soon started to hinder our visibility and of course that of the baboons. Our strategy then was to detail each of us to each foraging party and record feeding observations as regularly as possible. This approach enabled us to keep nearly all the three or so parties of a moving troop under simultaneous observation.

The tolerance distance stated above coupled with growing grasses which lowered visibility necessitated the use of binoculars to aid our vision most of the time. The food items being utilised were noted at irregular intervals and their remnants were collected as soon as the animals moved away.

Where possible, floral identification of a food item was done on the spot or later in the evening after the day's field trip. We found the texts of Hopkins and Stanfield (1966) and that of Irvine (1951) particularly useful in identifying trees that served as baboon foods. Similarly, Stanfield's (1970) work was indispensable in identifying the grasses as was the text of Lowe and Stanfield (1974) in identifying the sedges. Mention must here be made of the invaluable contribution which my field assistants made towards easy field identification of many plants. They know the vernacular names of most of the plants and we capitalised on this knowledge as the basis of floral identification.

All identifications done by us were later referred to either the Kainji Lake Research Institute or the Forestry Research Institute of Nigeria for cross-checking, while all those plants which we could not identify by ourselves were identified by either Institute. The herbarium was discarded at the end of the investigation.

5-1.4.3 Faecal Examination, not Analysis

Faecal examination was done because we were finding it almost impossible to detect the eating of insects and other small items by the baboons. We did not contemplate faecal

analysis not only for reasons of time limit but also because of the sources of error inherent in the exercise as discussed by Lockie (1959). Data based on faecal examination are necessarily qualitative and in this case are only meant to indicate what we found difficult to see the animals pick and eat.

Each time we encountered baboon faeces, it would be collected in a small polythene bag and assigned a serial number and then classified as from either an adult or a juvenile baboon. It was very easy to distinguish the two groups of faecal droppings on the basis of size which varies directly as the animal size.

Where the faeces was damp, it was immediately sorted for insect remains. Otherwise it was dampened with water to facilitate immediate examination and sorting of wings it might contain. Wings of termites and unidentified beetles in each category of faeces were recorded as "absent", "few" or "plenty". Wing remnants numbering 20 and upwards were marked as "plenty" while below that figure was scored "few". In all, we examined 235 faecal droppings of adult baboons and 198 of juveniles. The disparity in number was most probably due to the fact that adult faeces is more conspicuous than juvenile droppings. However, it is not impossible that adults defaecate more frequently than the juveniles.

5-1.5 Feeding Behaviour

5-1.5.1 Feeding Techniques

The baboons, as has been mentioned, are omnivorous, although mainly vegetarian. We saw, like Hall (1962a) no evidence of two peak periods of feeding but rather a more or less continuous process of diurnal feeding. This is quite unlike two peak feeding bouts reported for chimpanzees (Goodall, 1963). The term "feeding Period" seems almost inapplicable to the baboons. Feeding is not collective and it varies with the individual who does it throughout the day-time whenever it comes across anything edible.

Baboons young and old and of both sexes were observed habitually to brush grit and dirt from their food not only by the use of fingers and mouth but also by dashing the item against tree branches. Although they still suffer dental attrition, (Bramblett, 1969) presumably the severity of the attrition is thus reduced. The young animals tended to watch the older ones and copy the habit. Frisch (1968) has reported that in Japanese macaques, Macaca fuscata transmission of food habits occurs more readily from dominant to subordinate animal. Since the macaques and baboons are similar in many respects (Hall, 1966) this

conclusion might well be applicable to the latter as it certainly is as far as the removal of grit and dirt from food is concerned.

The baboons under observation were fond of fruits, dug-out tubers and corms as plant foods while, termites constituted the bulk of their animal food. The fruits and termites are easy targets which the baboons could have within a short time. This was not so in the case of tubers/corms which the animals had to waste time to dig up and a few extra minutes to rid of grit and dirt.

The technique which the baboons employ in digging up tubers and corms was remarkably efficient. In digging, the animals were almost always careful not to tamper with the aerial part until they had significantly exposed the sub-terranean target. Digging was usually done by the old ones often using both hands. The dug-out storage organ was then hand-picked, freed of grit and eaten. However, if the organ was deeply rooted, it would be chipped with the mouth while still buried. Invariably this left some inaccessible bits. It is then that the juveniles, with their smaller heads which could go further down into the pit, would come up and chip off the remnants as far as

they too could. Holes dug around underground storage organs could be as deep as 15.2 cm. (6 in.) and as wide as that in diameter.

The fore-going case looks like food-sharing of some sort for although Washburn and De Vore (1961) say there is no food-sharing among baboons, this behaviour exists as pictorially illustrated by de Edciones (1970) in a plate showing two individual baboons sharing a young gazelle. If baboons could share much-prized animal food, they might easier share the more plentiful plant foods.

We did not see baboons chase or eat any insect, not even the termites on their swarming nuptial flights. It is therefore likely that the insect remains found in their faeces resulted from an almost effortless capture of the insects. Our observations did not reveal the insectivorous feeding technique of the baboons.

There was certainly no single case of baboons chasing any animal for any purpose. On one occasion when there was general screaming and agitation in a troop, we were preparing ourselves for watching what we thought was to be the first case of prey chasing by any baboon troop in the KLNP. Instead, the incident turned out to be one in which the baboons were running away from an on-coming herd of elephants.

5-1.5.2 Feeding Heights

Fruits constituted the bulk of the diet of the baboons. For this reason most feeding would be expected to take place on tree tops. This was not the case. Most of the fruits were hand-picked by the baboons on the ground. In only 10 per cent cases of our observations did feeding take place on tree tops and such cases were restricted to the rainy season. Tree-top feeding was necessitated probably by two factors. One was that unripe fruits had to be forcibly detached from the trees. The other is that a heavy rain might confine the animals to well-foliated and fruiting trees, in which case they would start or continue feeding on the fruits. This habit was observed to be very common on the plants of Diospyros mespiliformes.

All other food items apart from fruits were available only on the ground or sub-terranean level.

Thus although the baboons feed on both arboreal and ground/sub-ground levels, most of the feeding takes place on the latter stratum.

5-1.6 Diet and Dietetic Composition

5-1.6.1 Floral Diet

The floral diet of the baboons as observed during this study consists of fruits of 13 selected tree species, underground storage organs of four herbs and the leaf-bases of two grass species. The 13 trees are all dicots as are two of the herbs while the monocots number four.

In terms of gross number there are more grass or monocots than dicots in the Park. The use therefore of 15 dicot species as compared with four of monocots reflects that the baboons show preferential utilisation of dicots (Ho : $\chi^2 = 6.25$; $P < 0.05$; d.f. = 1). Ho implies that equal utilisation is assumed and this even enhances the significance of the preference shown for the numerically fewer dicots.

5-1.6.2 Dry Period

During the dry period of this investigation, only eight plants were utilised, seven of them dicots. In five of these, fruits were the only items utilised by all classes of the baboons. Three leguminous fruits were even consumed dry during this period. The other three are herbaceous and

only their underground storage organs were utilised. The organs are root tuber, corm and rhizome as shown in table 25 which also contains all relevant information on the plants used by the baboons during this period.

Butyrospermum paradoxum usually in fruit between April and early July was the most extensively used plant during this period and it constituted 33.26 per cent of the total items utilised. Tamarindus indica was next, recording 31.38 per cent of total items eaten during the dry period. The lowest floral utilisation in the rainless period was obtained for the fruits of Acacia sieberiana. Of the two plants with sub-terranean storage organs the one with root tuber, Cochlospermum tinctorum was more extensively used than the other Gladiolus unguiculatus containing corm. The respective uses for the two were 13.74 per cent and 8.42 per cent. The former seems to be favoured not only because of its much larger size than the latter but also because of its much greater water content. On the average, each root tuber is about eight times the size of a corm and the slightest pressure was enough to squeeze water from it. Only a single species of sedges, Mariscus alternifolius had just its rhizome utilised by the baboons during the dry period. As soon as the rains came it was sub-merged by the

Oli River and was therefore no longer available for the baboons.

In all, during the dry period of study 3,776 feeding observations were made and recorded.

5-1.6.3 Rainy Period

The number of feeding observations during the longer period of rains was 13,496. The much greater number during rains was due to the longer period involved during the rains as well as the fact that food items started to increase in availability. Table 26 summarises information on the plants utilised by the baboons during this period.

Out of the eight species utilised in the dry period, the baboons continued to use five in the rainy season. Only Cochlospermum tinctorum and Kigelia africana were not in use any longer. Most probably, the former was no longer needed for its water due to widespread formation of rain pools. Besides, the availability of more readily accessible food items is expected to reduce the desire for tuber digging which is time-wasting. The other plant, K. africana was out of fruit at this period. Apart from the five species whose

utilisation in the dry period was carried over into the rainy season, 11 new floral species were introduced into the diet of the baboons.

The 16 plant species utilised during the wet period consist of 12 dicot trees, one herbaceous dicot, two grass species and one lily type. This gives a proportion of 13 dicots to three monocots. On the basis of Ho the following conclusions are reached on baboon food preference:

(i) dicots are significantly preferred to monocots ($\chi^2 = 6.25$; $P < 0.05$; d.f. = 1)

(ii) trees are selected in preference to other sources of floral diet ($\chi^2 = 4$; $P < 0.05$; d.f. = 1)

All the trees involved supplied fruits and they constitute 92.3 per cent of the dicots used.

Table 25. Plants Utilised During Dry Period of Study

Plant Name	Family	Part Used	Users		Frequency of Overall	
			Adult	Young	Use	% Use
1. Butyrospermum paradoxum	Sapotaceae	Fruit	√	√	1256	33.26
2. Cochlospermum tinctorum	Flacourtiacene	Root Tuber	√	√	519	13.74
3. Gladiolus unguiculatus	Iridaceae	Corm	√	√	318	8.42
4. Kigelia africana	Bignoniaceae	Fruit	√	√	267	7.07
5. Tamarindus indica	Caesalpin-iaceae	Fruit (Dry)	√	√	1185	31.38
6. Acacia sieberiana	Mimosaceae	Fruit	√	√	49	1.30
7. A. hockii	Mimosaceae	Fruit	√	√	82	2.17
8. Mariscus alternifolius	Cyperaceae	Rhizome	√	√	100	2.65
TOTAL					3776	

Table 26. Plant Diet in the Rainy Period

Plant Name	Family	Part Used	Users		Frequency of Overall	
			Adult	Young	Use	% Use
1. Butyrospermum paradoxum	Sapotaceae	Fruit	√	√	1147	8.50
2. Gladiolus unguiculatus	Iridaceae	Corm	√	√	40	0.30
3. Parinara polyandra	Rosaceae	Fruit	√	√	654	4.85
4. Piliostigma thonningii	Caesalpiniaceae	Fruit	√	√	739	5.48
5. Detarium microcarpum	Caesalpiniaceae	Fruit	√	√	1628	12.06
6. Diospyros mespiligormes	Ebenaceae	Fruit	√	√	1183	8.77
7. Tamarindus indica	Caesalpiniaceae	Fruit	√	√	1231	9.12
8. Nauclea latifolia	Rubiaceae	Fruit	√	√	1176	8.71
9. Vitex doniana	Verbenaceae	Fruit	√	√	1056	7.82
10. Ficus sycomorus	Moraceae	Fruit	√	√	22	0.16
11. Strychnos spinosa	Loganiaceae	Fruit	√	-	325	2.41
12. Acacia siberiana	Mimosaceae	Fruit	√	√	972	7.20
13. A. hockii	Mimosaceae	Fruit	√	√	1003	7.43
14. Andropogon gayanus	Graminae	Leaf-base	√	√	671	4.97
15. Hyparrhenia rufa	Graminae	Leaf-base	√	√	623	4.62
16. Albuca nigritana	Liliaceae	Bulb	√	√	1026	7.60
TOTAL					13496	

Table 27. Plant Diet in Dry and Wet Periods

Plant Species	Plant Growth Form	Period of Major Use	No. of Observations	Overall % Use	Relative Abundance	Pattern of Plant Dispersion
1. Butyrospermum paradoxum	Tree	Dry & Wet	2403	13.91	Common	Scattered
2. Cochlospermum tinctorum	Herb	Dry	519	3.00	Uncommon	Scattered
3. Gladiolus unguiculatus	Herb	Dry	358	2.07	Uncommon	Scattered
4. Kigelia africana	Tree	Dry	267	1.55	Uncommon	Clumped
5. Tamarindus indica	Tree	Dry & Wet	2416	13.99	Common	Scattered
6. Acacia sieberiena	Tree	Wet	1021	5.91	Common	Clumped
7. A. hockii	Tree	Wet	1085	6.28	Common	Clumped
8. Parinari polyandra	Tree	Wet	654	3.79	Uncommon	Scattered
9. Detarium microcarpum	Tree	Wet	1628	9.43	Common	Clumped
10. Diospyros mespiliformes	Tree	Wet	1183	6.85	Common	Scattered
11. Nauclea latifolia	Tree	Wet	1176	6.81	Uncommon	Scattered
12. Vitex doniana	Tree	Wet	1056	6.11	Uncommon	Scattered
13. Ficus sycamorus	Tree	Wet	22	0.13	Rare	Scattered
14. Strychnos spinosa	Tree	Wet	325	1.88	Uncommon	Scattered
15. Andropogan gayanus	Grass	Wet	671	3.88	Common	Clumped
16. Hyparrhenia rufa	Grass	Wet	623	3.61	Common	Clumped
17. Piliostigma thonningii	Tree	Wet	739	4.28	Uncommon	Scattered
18. Albuca nigritana	Herb	Wet	1026	5.94	Uncommon	Scattered
19. Mariscus alternifolius	Herb	Dry	100	0.58	Restricted	Clumped
TOTAL			17272	100%		

Table 28. Plant Diet Classified on Basis of Growth Form

Plant Growth Form	No. of Species	No. of Observations	Parts Utilised (=100% in all cases)	Overall % Use
Trees	13	13,975	Fruits	80.91
Shrubs	0	0	-	0.00
Herbs	4	2,003	Underground Tubers	11.60
Grasses	2	1,294	Leaf-bases	7.49
Others	0	0	-	0.00
TOTAL	19	17,272		100%

Table 29. Occurrence of Insect Wings in Baboon Faeces

Insects	Termites						Beetles					
Baboon Age-Class	Adults			Juveniles			Adults			Juveniles		
Wing Frequency	Abs.	Few	Plty.	Abs.	Few	Plty.	Abs.	Few	Plty.	Abs.	Few	Plty.
	0	2	233	195	3	0	0	150	85	195	3	0
Percentage Occurrence	0.00	0.85	99.15	98.48	1.52	0.00	0.00	63.83	36.17	98.48	1.52	0.00

5-1.6.4 Overall - Dry and Rainy Periods

Overall, 17272 feeding observations were recorded throughout the entire study period. These are made up of 3,776 in the dry periods and 13,496 in the wet period. Nineteen plant species were utilised by the baboon during the observations. Table 27 gives the necessary information on the floral species involved. Thirteen of these are dicot trees, two are dicot herbs while the remaining four are herbaceous monocots. This gives a ratio of 15 dicots to four monocots. It has previously been shown that the baboons significantly prefer dicots to monocots ($Ho : \chi^2 = 6.25$; $P < 0.05$; $d.f. = 1$).

If the 17,272 records of feeding observations are categorised according to the growth forms of the plants, (table 28), some facts emerge. One is that only trees and herbs were utilised by the baboons. The second is that we observed no single use of any shrubs or any other form of plant growth. Thirdly, results indicate that the baboons utilise selected portions of any plant growth form on which they feed. Thus only the fruits of trees were consumed, the utilisation of the herbs was restricted to their underground storage organs while only the leaf-bases of the grasses were observed to be eaten.

As shown in table 28 utilisation frequency is highest for dicot fruiting trees and lowest for grasses. The use of χ^2 statistic points out preferential selection of fruiting trees over all the other forms of plant growth combined (Ho : χ^2 = 6851; $P < 0.001$; d.f. = 1). Fruits are the important variable. In sum, the overall data on floral diet of the baboons show that this consists of 81.49 per cent fruits, 11.02 per cent underground storage organs (corm, bulb and root tuber) and 7.49 per cent leaf-bases of grasses.

From the above statistical and per cent analysis of floral diets, the inevitable conclusion is that the baboons are selectively and mainly frugivorous. This conclusion falls in line with that drawn by Clutton-Brock and Harvey (1977a) who reviewed literature on feeding ecology of some 56 primate species. Underground storage organs rank next in importance to fruits in baboon diet and they are significantly more utilised than the leaf-bases of grasses (Ho : χ^2 = 116; $P < 0.001$; d.f. = 1).

5-1.7 Non-vegetarian Diet

In the course of this investigation insects - termites and beetles - alone constituted the non-vegetarian food items utilised by the baboons. Thus these insects are the source of animal protein for the baboons.

The utilisation of insects as food by the baboons was never directly observed by us. We depended on faecal examination to reveal this fact and as far as we could make out only termite and beetle wings were associated with the collected faeces of the baboons. Both adults and juveniles utilise these insects, though to a very small proportion in the latter. The observations on which this conclusion is based are displayed in table 29.

All the adult faecal droppings examined contained termite and beetle wings. In 99.15 per cent of the 235 cases the quantity of termite wings was "plenty". Only 36.17 per cent of the faeces contained "plenty" of beetle wings. Thus more termites than beetles were utilised by adult baboons. With the juveniles a mere three out of 198 faecal egestions simultaneously contained termite and beetle wings. This amounts to 1.52 per cent of the total faecal droppings of juveniles that were examined.

Insects apart, no other type of animals were utilised by the baboons during our investigation. On one occasion, a number of baboons were almost hysterical and running in the same direction. We thought we were about to witness for the first time a hunting act by baboons in the Park. They were running away from an approaching herd of elephants.

From the fore-going observations, it seems that cases of carnivorous feeding and even systematic hunting by baboons are a feature of baboons inhabiting areas which do not contain enough floral and insectivorous diets to meet their dietetic needs. In one such area in Kenya, there is a photographic evidence (Packer and Collins, pers. comm.) of a male baboon eating the flesh of a dead young baboon. Perhaps only an acute shortage of food in the habitat could have driven a baboon to what sounds like an extreme! This suggestion on food shortage may in part account for why we did not see any evidence of carnivorous behaviour in the KLNP baboons whose habitats are fairly productive.

However, it was quite possible that we were just not opportuned to see baboons eat flesh or that for unknown reasons the KLNP baboons are yet to acquire carnivorous habit.

5-1.8 Feeding Selectivity

5-1.8.1 Degree of Selectivity

5-1.8.2 Fruiting Trees

In this study the list of plant species utilised by the baboons does not parallel the order of occurrence of the species. The dominant trees - Burkea africana, Terminalia avicennoides, Afzelia africana and Isoberlinia tomentosa - were never utilised by baboons even where their fruits were readily available. Acacia spp, another dominant plant group were largely used in areas where they are not widespread. The sixth dominant plant, Detarium microptera was the only type-species that was extensively used in the wet period.

On the other hand, the common but non-dominant Butyrospermum paradoxum and Tamarindus indica were utilised so extensively when in fruit that they virtually dominated the movement patterns of the baboons at such times. Indeed, so great was the animals' preference for the latter species that they even ate its dry pods. Occasionally, the dry pods of Acacia sieberiena and A. hockii were also eaten but to a much lesser extent.

A number of plants bearing fruits were clearly avoided by the baboons. The most prominent of these were Gardenia ternifolia and Terminalia macroptera. The fruit of Ficus sycamorus was eaten only moderately in spite of its availability. Likewise, the fruit of Strychnos spinosa was moderately used but did not seem to be deliberately sought after by the baboons.

Baboons are reported to eat flowers rather commonly. In no single instance did we see any baboon touch or eat the flower of any of the array of species that were in flower. Perhaps they were saving the flowers to enable them to supply fruits, the major diet of the animals.

Food selection ratio , an indication of the degree of selectivity for different tree species is the quotient of relative utilisation and relative abundance of the species as estimated from enumeration of trees (Waser, 1977). In the absence so far of any detailed tree inventory of the KLNP, this ratio cannot be determined. However, from our observations, it is almost certain that Tamarindus indica should top the list with the highest selection ratio and that this is likely to be followed rather closely by Butyrospermium paradoxum. One could be almost sure that with the exception of Detarium

microptera the dominant tree types would have the lowest selection ratios.

Tree selectivity for floral food as observed in the KLNP baboons has been similarly reported for the lemur in Madagascar (Pollock, 1977).

5-1.8.3 Non-woody Plants and Shrubs

There was no evidence of utilisation of any shrub item by the baboons in the course of this study.

Of the many herbs having storage organs subterraneanly, only four were used at all. The varieties of lilies in the Park were not utilised as food, their wide distribution notwithstanding. The only exception was Albuca nigritana. Had they chosen to feed on lily bulbs, the baboons could have had more than enough for their fill immediately the first few rains fell.

Similarly, only two of the multifarious species of grasses were used as food. Even then, the use was confined to leaf-bases which are actually succulent stems. The dominant Andropogon spp were never utilised by the baboons even when the leaves were young and tender. Such tender

grass leaves are relished by the grazers in the Park and one would not expect the baboons to disregard them as they did. That the baboons did not graze might be due to the possibility that their alimentary system is not capable of effective digestion of grass leaf fibres. Thus for example their faecal droppings contained plenty of fibres of the fruit of Kigelia africana.

All the recorded observations on the floral diet of the baboons indicate that the animals show a marked degree of floral food selectivity. Similar observations have been reported for gelada baboon (Dunbar, 1977), for the rhesus (Lindburg , 1977) and for the mangabey (Waser, 1975 and 1977). Incidentally the macaque and rhesus monkeys are relatives (Eaton, 1976) and the former are closely related to the baboons (Hall, 1966). This means that baboon and rhesus groups are related and may in part explain why all three species referred to in this paragraph show identical floral food selectivity. This behaviour, however, is not unique to them as Clutton-Brock (1977a) has rightly pointed out on the basis of his review of literature. He states that all non-human primates so far studied are highly selective in their choice of foods and that they often consistently select only the specific parts of particular species.

The conclusion from this study then is that the baboons are highly selective of their floral diet locally but that from literature indications they show regional variations in keeping with the best food items which each area could offer them.

5-1.8.4 Insectivorous Diet

Although not much reliance could be placed on faecal examination for insect remains, it is noteworthy that only termite and beetle wing remains were found in most of the baboons' faecal droppings. We found no trace of common grasshoppers and butterflies or any other insects whatsoever.

5-1.9.1 Intra-troop Dietary Variation

We saw no evidence of sex differences in baboon feeding behaviour. Adult males and females were feeding on similar selected items without any apparent difference in rate or extent of use. Dunbar (1977) made similar observations on gelada baboons and from his data, concludes that the adult females because of their much smaller size, must consume proportionately more food per unit body weight than the heavier males. This situation, he goes on to suggest, is probably attributable to the female nutritional requirements of gestation and lactation.

The evidence of intra-specific dietary variation which we observed stems from age-class variation. Whereas all adults utilised all the food items listed under diet, the juveniles exhibited only partial use in some cases. They never fed on the hard seed of Butyrospermum paradoxum but ate only the fleshy epicarp of the fruit. Most probably, their teeth were not yet strong enough to crush the hard endocarp surrounding the seed or else they had not learnt to do so. The fruit of Strychnos spinosa was never used by the juveniles. The exocarp was certainly too hard and tough for them to manipulate. The third variation in diet shown by the juveniles was in respect of utilisation of insect food. Unlike the adults, the juveniles utilised insects to an almost negligible degree. They were probably just learning the insectivorous habitat.

5-1.9.2 Concluding Remarks on Baboon Diet in the KLNP

The utilisation of dry fruits by baboons sounds odd, although Crook and Aldrich Blake (1968) made similar obser-bations. It is quite possible that relative scarcity of fruits in the dry period drove the baboons to the habit. More than that however, it might be that the dry fruits which the baboons selected were capable of supplying their nutritional needs. The avidity exercised by the animals in using the dry

fruit of Tamarindus indica in particular is better seen than described. It is certainly worth the while of physiologists/biochemists to assess the nutritional value of the dry pods of this plant in order to have an idea of the feeding behaviour which baboons display towards it. Its utilisation seems unjustified by the fact that the faecal droppings of baboons seem to indicate that they cannot digest the seeds.

The writer wishes to emphasise that the list of 19 floral species is likely not to be exhaustive of the floral foods of baboons. In spite of our efforts to the contrary, we probably must have missed some items which the animals utilised. This is a general limitation of field observations particularly where the vegetation might obscure vision occasionally as in the KLNP. We recorded all food items we saw the baboons utilise. Further work might yield a larger number of plant foods not only because this investigation probably failed to do so, but also and more because the animals could add new items to those we observed them to utilise.

5-2 WATER UTILISATION

5-2.1 Baboons Require Water

Enough has already been said to show that baboons require water. Kummer (1971) contends that the animals must find and use water daily while Hall (1962a) records irregular and few cases of water utilisation by baboons. It is perhaps a good compromise to say that baboons require regular access to water (Hall, 1966) but that they could do without it for quite some time in areas where their diet contains a high moisture content (Altmann, 1974).

Water distribution in the Park has earlier been dealt with. Suffice it to recall that in the dry season only a few water-holes contain potable water, though most of the rivers resume their flow with the fall of rain over a number of times. In addition to these water bodies, an additional source of water for the baboons are the many rain puddles which form here and there with the onset of rains.

5-2.2 Frequency of Drinking and Drinking Behaviour

The KLNP baboons will utilise water either daily or irregularly depending on its availability and the moisture content of their diet. A troop without a source of water

in the dry period most probably assuaged its thirst by means of the water content on the fruits and water-containing tubers and bulbs it was feeding on. One that lived near the Oli River usually drank twice every day, first thing in the morning and later before ascending their lodging tree-complex for the night. The other two troops drank only once in the afternoons.

Baboons crouch down to lap water and generally spend some five to 15 seconds in the process. One animal might drink once, twice or more number of times at one drinking session. The maximum we observed was four times in a period of 1.5 hours and this was by a sub-adult male.

The baboons as a group are reported to drink water rather hastily (de Ediciones, 1970). This view is not in evidence in the baboons of Nigeria which live in savanna woodland. Henshaw and Ayeni (1971) have found that some baboon populations in Nigeria spend about 18.1 minutes each time they visit water/soil licks. Our study shows that when the KLNP baboons come to a source of water where the vegetation provides shade, they spend between 45 minutes and 1.50 hours by the bank. This is probably because although they might have come to the river primarily to drink they also find

the shaded and cool environment of the banks ideal to relax from the heat of the day. It would appear that the troops involved harboured no fear of being surprised by predators for although they looked vigilant, they felt so generally easy and relaxed.

With the formation of rain pools, there was no "organized" drinking of water any more. Each animal in the group started to drink apparently whenever it felt like it and there was then no period that could be correctly referred to as a "drinking session". Thus, in the face of restricted water supply, drinking is a troop-directed behaviour but this order breaks down when water supply becomes universal in the habitat.

We had evidence that tends to suggest that some baboon individuals might care about the neatness of the water which they drink. A puddle of water infested with algae and scum was readily drunk by a juvenile but not by a sub-adult male which neglected the polluted water. Instead it dug a pit nearby until it reached a clear body of water below the soil. It then drank its fill before looking for more food as is usual with the animals. Most probably, the juvenile had not learnt to dig for water or had not found it necessary to discriminate between apparently polluted and neat water.

From our observations it could be concluded that baboons in the KLNP are water-dependent. They would gladly have it in pure form but are apparently content to obtain it through their diet where there is no alternative.

5-3 UTILISATION OF MINERAL LICKS

Henshaw and Ayeni (1971) state that lick areas contain a higher proportion of minerals than drier portions of a habitat and have suggested that water drinking and soil eating at lick sites probably supply the mineral needs of the animals. Ayeni (1972) has reported that the Nigerian baboon in Yankari makes extensive use of natural licks.

We observed baboons handle empty bivalve shells. They were presumably salt-licking the items. We later saw indications of such shells being piled up away from the banks of the Oli River. The sighting of baboon tracks in such areas suggest that the baboons brought the shells there. The possibility of their eating the bivalve flesh might exist but is less likely than the one that the shells were collected for mineral-licking by the baboons.

5-4 CROP-RAIDING BY BABOONS

5-4.1 Crop-raiding Documentation

Crop-raiding by wild vertebrates is almost commonplace and is in no way peculiar to the baboons. Ritchie

(1931) gives the names of various pests on British livestock, crops and pastures as well as property: the notorious ones are the fox, the rabbit and the wood-pigeons. Pestiferous habits have been reported also for warthogs (Bernhard and Gr zimek, 1960) hyaenas (Kruuk, 1976), sykes monkey (Omar and De Vos, 1970), vervet monkey (Astley Maberley, 1963) and the patas (Hall, 1965b). Birds are no exceptions (e.g. Crook and Ward, 1968; Ridpath and Meldrum, 1968a and Houston, 1974).

However, there is perhaps no better documented evidence of crop raids by mammalian vertebrates than that for the baboons in virtually every area of its distribution. In South Africa, Stevenson-Hamilton (1947) reports that when baboons are on the forage, any unguarded field lying in their path is ruined. Dabo (pers. comm.) says that baboons are injurious to agriculture in Kenya, just as they could be in Uganda (Bere, 1962). In Nigeria, Collier (1953) alludes to the baboons as greedy raiders of maize while Howell (1968b) refers to them as "farm robber par excellence". The array of crop-raiding evidence against baboons has been concisely summed up by Smithers (1966) who refers to them as "great raiders of crops of all descriptions" in addition to which they raid farm animals (Marais, 1939) and poultry (Maples et al, 1976). Apart from raiding crops and livestock, the baboons are known to cause other forms of destruction like wrecking trees and damaging cars (Chipperfield, 1975).

5-4.2 Why the Baboon is an Agricultural Pest

All things, living or otherwise are connected. That this connection between man and baboon often results in agricultural conflicts becomes less surprising if it is realised that inter-specific competition is a characteristic feature of any ecosystem.

Man's land-use activities have helped in modifying the African habitats. As a result, many wildlife forms have suffered large population reductions while others, finding these alterations to their liking, have substantially increased and become problematic to man (Howard, 1962 a,b.). The baboon has certainly benefited from such alterations and is, according to Maples (1969), one of the animals that adapt to the spread of agriculture in Africa. Dietary adaptability of the baboons makes it possible for them to take advantage of whatever staple food items the local area or 'man-created food opportunities' may offer (Hall and De Vore, 1965).

There is a great deal of overlap in food items utilised by both man and baboon. The baboon utilises fruits, herbs and insects and shares many of these with man where it coexists with him. A few of such mutually-utilised foods includes the fruits of the mango, Mangifera indica,

Irvingia gabonensis, Vitex doniana, the banana, Musa spp., the cashew, Anacardium occidentale and that of the shea-butter tree, Butyrospermum paradoxum. The corm of the herb Gladiolus tinctorum is consumed by both man and baboon. The termite is a delicacy to the baboon and to many Nigerians, particularly the young ones who share this characteristic with their counterparts in many parts of Africa.

The few examples cited above indicate that man and baboon share many uncultivated food items in common. Man's cultural practices could therefore be regarded as contributing additional food items to those which he and the baboon already utilise in common. Indeed, this is what actually happens.

It is not always a simple matter to determine a pest since there is as a rule a mixture of good and evil in every creature (Ritchie, 1931). Man must in fact come to live with occasional loss of his agricultural products to many wildlife species so long as such loss could be tolerated by him. Unfortunately in the case of the baboon it would appear that its activities cause staggering and unbearable loss to the farmer. Little wonder it has such a disrepute as a pest. Therefore as an 'actual' rather than a mere 'potential' pest, the baboon is an animal whose control is an economic necessity.

5-4.3 Crop-raiding Techniques

Crop-raiding by baboons may be casual or systematic. When casual, the habit is most probably part of the general foraging behaviour of the baboons. On the other hand, deliberate systematic raids, because of the risks involved, are not likely to be engaged in unless food necessity compels: even then, the practice will probably be minimal. Be that as it may, the animals seem to be able to adapt to the menance of crop-raiding.

Baboons are reported by Stevenson-Hamilton (1947) to post sentries when employed in a raid on cultivated lands and according to Zuckerman (1932) they conduct such raids in a manner suggesting pre-conceived planning of so high an order that the farmers' counter-attacks have to be very subtly arranged. Such arrangements and other measures notwithstanding, man seems not to be succeeding in ridding himself of the menace and the problem remains.

Perhaps the main reason why the campaign against baboons as pests has generally not succeeded is due to the specialised raiding techniques which they display. Maples (1969) has observed that crop-raiding baboons sometimes seem to divert the attention of guarding farmers to one location where some of the animals are present thereby leaving the

others free to raid crops at other locations. Although Maples (1969) and Maples et al (1976) do not regard such diversionary raiding tactics by baboons as intentional, the point is that such antics enable them to make success of crop-raids even where the farmer keeps watch!

5-5 FACTORS LIKELY TO AFFECT CROP-RAIDING BY BABOONS

Crop-raid, casual or systematic, is an inevitable consequence of animals sharing identical food habits with man. As earlier mentioned it is more casual than systematic and Maples (1969) has even reported that the former is very widespread in Kenyan baboons.

Some factors that are likely to affect crop-raiding by baboons include the following:

1. Baboon Population
2. Location of the Farm
3. Type of Crop
4. Size of the Farm
5. Man's Cultural Practices, particularly
   (i) shifting cultivation and
   (ii) crop rotation
6. Human Attendance on the Farm.

Each of these factors will now be briefly discussed.

5-5.1 1. Baboon Population

To be a serious pest an organism has to occur in rather large numbers so than man can no longer tolerate the depredation it causes. The larger a population, the wider

its area of dispersion and the greater its chances of emigration. Under these conditions, the more damage or depredation the population will likely cause. Ridpath and Meldrum (1968b) have related crop damage by the Tasmanian native hen, Tribonyx mortierii directly to their number.

A pest species that cannot keep its number high is doomed to extinction in the face of incessant campaign by man where he is the victim. The importance of an animal's number is underscored by the common control practice of trying to reduce game density to a tolerable level in order to minimise the damage it causes.

5-5.2 Location of the Farm

The presence of water, tree clusters with good canopy and rock outcrops indicates a potential range area of baboons. Any farm near such a place stands a high risk of invasion by baboon populations. The more distant a farm is to such an area frequented by the animals, the better its chances of escaping depredation or damage.

It has been emphasised that baboons are cautious when they approach a road or an open area. This suggests that a farm near such locations will tend to frighten off the animals who, when liable to persecution, fear being exposed to man.

There is every reason to believe that this is one of the reasons why the Nigerian peasant farmers cultivate by the road-sides where they have the opportunity. On the other hand, a farm that is surrounded by uncleared bushland and thicket gives effective cover to the baboons and their crop-raiding potential.

Even if a fairly-long distance from a baboon haven does not prevent raids it is likely to diminish its frequency and extent. This is because baboons feed rather avidly in the morning and diminish its intensity as they forage on. For this reason, a farm which is remote from them will be reached when most of them would have been partially filled with food. This implies that a farm which the baboons reach in the morning will certainly suffer more destruction than a similar one which they could reach only many hours later in the day.

5-5.3 Type of Crop

Fruiting crops are ideal raiding targets by baboons. This is not only because the Nigerian baboon is mainly frugivorous but also because little time is wasted in ridding a plant of its fruit. This contrasts with the time-wasting process of digging for tubers. Therefore crops like yam and cassava which have tubers that have to be dug up in order to

be utilised are not likely to be exposed to raids by baboons as would be maize or other fruiting crops. The mainly frugivorous feeding habit of the Nigerian baboon protects, to a large extent non-fruiting crops. Farms containing such crops are therefore not likely to be favourite raiding targets for the marauding baboons.

5-5.4 Size of the Farm

The larger the size of the crop field, the more conspicuous it is. Also, the smaller the farm the easier it will be for the farmer to keep vigil over it. The foregoing ideas suggest that all other things being equal larger farms are more likely to be raided than smaller ones.

However, large farms possess the advantage that they might be damaged only in part during a raid that will totally destroy a small farm. As far as the size of the farm goes, it becomes an important factor only in conjunction with the location of and vigil over the farm.

5-5.5 Man's Cultural Practices

The baboons are at home in man-induced savanna areas of Africa. In Nigeria, this vegetation type is increasing in scope due to man's cultural activities, particularly shifting cultivation and its companion, bush-burning.

This practice opens new areas for the baboons to explore. It will not come as a surprise if the so-called 'derived savanna' of Nigeria becomes invaded by the baboons which are most probably not there as of now.

On its credit side however, shifting cultivation may possess the advantage of not allowing the baboons to locate easily any new farming sites since the animals have usually fixed home areas and are fond of using habitually traditional paths when they forage.

Crop rotation on the other hand, does not make new farmlands available to potential crop-raiding baboons and unlike shifting cultivation it does not significantly alter an already established farmland ecosystem. Changing crops seasonally and raising those that baboons might have to labour much to obtain - examples are yams and cassava - might help to keep the animals away over a length of time.

The use of shifting cultivation and crop rotation is an attempt to separate the pest from its host crops both in time and in space. This practice normally reduces and delays attack by pests (van Emden, 1974).

5-5.6 Human Attendance on the Farm

Man is the baboon's worst enemy. It therefore tends to avoid him except in a few places where it is effectively protected and therefore faces little or no danger from man. The mere presence of human beings is usually sufficient to check any intended damage to a farm by the baboons. Nigerian crop pests generally do not dare the presence of the farmer or a passer-by. Maples (1969) has observed that crop-raiding baboons usually leave as soon as their presence is detected and that they seldom return the same day.

Therefore a farm which is attended vigilantly by people in the day-time is almost certainly free from raids by baboons. Conversely, an unattended farm offers itself a target for raiding not only by baboons but by other vertebrate pests as well.

CHAPTER 6

B A B O O N T I M E - B U D G E T

CHAPTER 6

B A B O O N T I M E - BUDGET

6-1 METHOD

In the course of day-ranging with our four selected troops of some 128 baboons, we took records of the activities they spent their time on. The details of scanning method used for taking records of feeding observations are also used in this case. Scanning approximately 310 animals daily for 119 non-consecutive days, we made 36,750 observations of animal activities. Each such animal observation constitutes an "individual activity record, IAR" (Crook and Aldrich-Blake, 1968).

Our initial attempts to distinguish IAR's on the bases of sex and age were found to be time-consuming and to diminish the volume of possible observations. They were therefore early abandoned. In taking our IAR's we arbitrarily divided each day into three periods:

I. Descent time (about 7.00 hrs.) - 12.00 hrs.
II. 12.00 hrs. - 15.00 hrs.
III. 15.00 hrs. - Ascent time (about 18.30 hrs.)

Period I is to be hereafter referred to as morning period while II and III will be called early and late afternoon respectively.

We set out to observe any activity the animals might engage in. However, only the following activites seemed important: barking (B), feeding (F), drinking (D), moving (M), playing (P), quarrelling (Q), grooming (G), copulating (C), sitting/still/resting (S) and soil digging (Di).

Details of feeding activities have been dealt with in Chapter 5. Other activities have not been quantified on seasonal basis and the method of data collection did not take habitat variation into consideration. This short-coming in data collection makes it impossible to have perhaps a way of comparing the quality of the habitats through general activities of the baboons.

6-2 RESULTS AND DISCUSSION

The frequency and per cent distribution of the IAR's for the baboons are given in the accompanying table 30.

Table 30. Baboon Activities and their Relative Frequencies

Activity	IAR Frequency	Per cent Distribution
Barking (B)	430	1.17
Feeding (F)	17,272	47
Drinking (D)	4,318	11.75
Moving (M)	1,102	3
Playing (P)	2,083	5.67
Quarrelling (Q)	488	1.33
Grooming (G)	2,664	7.25
Copulating (C)	0	0
Sitting/Resting (S)	7,504	20.42
Soil Digging (Di)	889	2.42
	36,750	100.01%

The results show that the baboons spent a very substantial part of the day in feeding, the score being 47 per cent. Sitting, standing still or resting ranked next with 20.42 per cent while the third most frequent activity was

water drinking which occurred in 11.75 per cent of total activities. The scores of other activities are as shown in Table 30. It is clear that the animals spend their time disproportionately between the component activities for the day. This behaviour conforms with usual primate behaviour as disclosed by Clutton-Brock and Harvey (1977a). Reviewing the literature on some 56 primate species, they report that primates show marked variation in the amount of time spent in different activites.

Figure 10 is a histogram of the activities and the percentage frequency of each. Inside each bar of the histogram is the exact percent frequency of occurrence of each activity.

Barking was most intense at the beginning of our observations. Baboons are wary of being observed and they often show this by barking and grunting. However, with time they seemed to accept our proximity within limits. This was indicated by less barking and grunting as well as the lessening of threat reactions directed at us mainly by the juvenile males. These older juvenile males were rather fond of shaking tree branches and making body movements aimed at frightening us. They stopped it after a number of weeks. However, there was no case of complete habituation by the baboons to us. Caution still ruled their behaviour towards us.

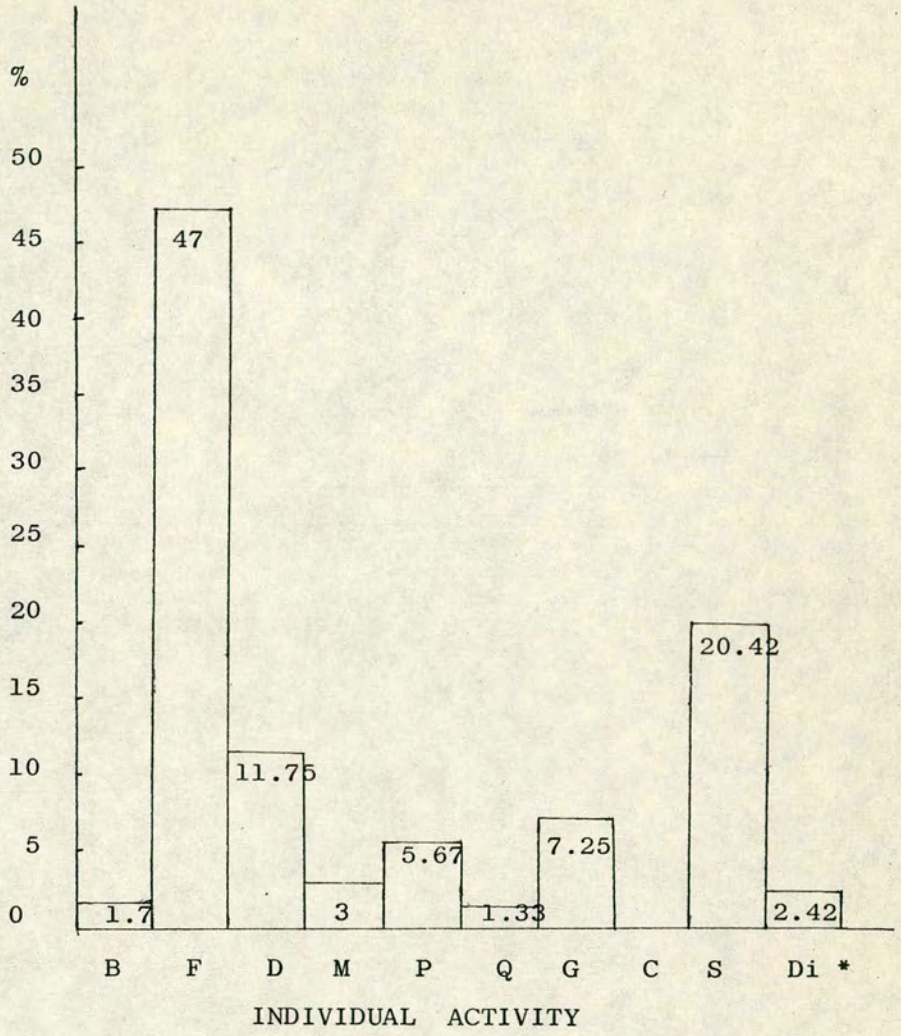


Figure 10. Histogram of Per cent Distribution of Baboons' Individual Activity Records, IAR's.

* See text for legend.

More than protesting our presence, barking was a means of vocal contact by the animals of a group. Thus it increased in intensity and frequency when the grasses flushed and visual contact became limited among the baboons. In addition to barking we observed a few group alarm calls each time the animals sighted a herd of elephants. This aspect will be elaborated and discussed under "Baboons and Other Animals".

In the night the baboon groups raised about 30 unusual alarm calls. Twenty-Five of these occurred on moonlight nights. This behaviour shows that the baboons extend their vigilance to night-time, especially during full-moon when visibility is usually good. On many such nights of alarm calls, we suspected that these had to do with lions, the chief potential felid predator of the KLNP baboons. This was not only because we heard lions roar simultaneously as the baboons screamed we also usually found later in the morning lion tracks near the lodge-trees of affected baboon troops. The coincidences were too overwhelming to be passed as mere chance. The two events were therefore almost certainly connected.

Soil digging was observed mostly in connection with feeding or drinking although on some occasions we were unable to understand the reason for this activity. In the latter

instance, a number of diggings were made unrelated to feeding and drinking. Perhaps the animals were turning the soil to examine its mineral-licking potential.

Grooming was mainly adult female to male affair although it was also observed a few times between juveniles and the adults. Simonds (1974) says that the former situation results in a weakened mother-lineage and gives rise to strong adult female-male social bonds. It is common knowledge that grooming is principally a dirt removing and de-lousing exercise. However, the direction of flow and its frequency among adult baboons may suggest that it also has some erotic value. Thus for example Kummer and Kurt (1965) have described the grooming behaviour as an "expression of high interest in the partner".

6-3 DIURNAL PERIODIC VARIATIONS IN ACTIVITIES

The baboons exhibited diurnal variations based on the three arbitrary periods the day had earlier been said to be divided. Table 31 displays these periods and the distribution of the activities as the latter occurred during each of them. Corresponding per cent occurrences are put in parenthesis. Table 32 shows the statistical significances of

these variations based on χ^2 statistic and assumed Ho. All the variations are statistically significant at 0.001 level.

Table 31. Diurnal Variation in IAR's based on Three Day-time Periods

Diurnal Periods / Activity	INDIVIDUAL ACTIVITY RECORDS (% IN BRACKETS)		
	7.00 - 12.00hrs. (%)	12.00 - 15.00hrs. (%)	15.00 - 18.30 hr. (%)
Barking	276 (64.19)	123 (28.60)	31 (7.21)
Feeding	7166 (41.49)	5157 (29.96)	4931 (28.55)
Drinking	980 (22.70)	1102 (25.52)	2236 (51.78)
Moving	520 (47.19)	153 (13.88)	429 (38.93)
Playing	460 (22.08)	980 (47.05)	643 (30.87)
Grooming	857 (32.17)	613 (23.01)	1194 (44.82)
Copulating	0	0	0
Quarrelling	0	122 (25.00)	366 (75.00)
Sitting	1960 (26.12)	3921 (52.25)	1623 (21.63)
Soil Digging	31 (3.49)	61 (6.86)	797 (89.65)

By coincidence each period had 12,250 IAR's taken during it. However the distribution patterns vary from one period to the other. Thus for example, barking was most common in the morning and lessened in the late afternoon. Feeding activity showed a similar pattern. At the other extreme, quarrelling was non-existent in the morning and rampant in the late afternoon while soil digging was minimal in the morning, and maximal in the late afternoon.

Table 32. Statistical Significance of Diurnal Variation for Each Activity - based on Three Arbitrary Daily Periods

Activity	χ^2 Value	d.f.	P Value	Inference on Diurnal Variation in Activity
Barking	213.722		$P < 0.001$	Highly Significant
Feeding	522.165		"	" "
Drinking	696.997		"	" "
Moving	198.864		"	" "
Playing	200.413		"	" "
Quarrelling	426.991		"	" "
Grooming	191.691		"	" "
Copulating	(Activity not observed)			
Sitting/Resting	1231.331		$P < 0.001$	" "
Soil Digging	1270.377		"	" "

Grooming alone seems to fluctuate least between the three periods. We did not observe any copulatory act.

Thus in all observed activities, intensity varied diurnally in varying degrees. The results indicate that baboon activities are performed when expendiency dictates. Feeding is most intense in the morning not only because it breaks overnight fasting but also because other competing animals would decrease food abundance as the day progresses. Moving is tied up with food searching and it therefore shows the same pattern of occurrence as does feeding. There was no quarrelling in the mornings presumably because attention was concentrated on essential activities like feeding and drinking. Playing, mostly by the juveniles, was most intense only after the animals had got some food to eat. Grooming was commonest in the late afternoons when most of the feeding must have taken place. Resting by way of sitting or standing still occurred 52.25 per cent in the early afternoons during the usually uncomfortable heat of the day.

It seems that the variation in intensity observed in many of the other activities is primarily dependant on feeding. All activities require energy which is derivable only from

food and until this is utilised to a reasonable extent other activities are likely to be minimal in intensity. The paramount importance of feeding accounts for its relative incidence of 7,166 observations out of a total of 12,250 morning period activities. This fraction shows that the animals spend 58.498 per cent of the morning periods on feeding.

6-4 ACTIVITIES NOT OBSERVED

Apart from the ten major activities that have been considered, baboons perform others. These include biting, frightening ignoring and according to Hall (1962b) "greeting".

We did not see a single case of mating or even presenting throughout the period of study although early morning erection was widespread among the older juvenile males. The apparent absence of copulation is surprising since according to Udrey and Morris (1968) most monkeys mate at all times during their menstrual cycles. It is therefore suspected that mating must have occurred on a few occasions we were not opportuned to see in spite of our efforts to keep special watch on two consort pairs in one of the troops. Lack of mating observations within a

reasonable period - six months in this case - is not peculiar to this study nor is its occurrence unique to the KLNP baboons. Hall (1963a) for example, did not observe a single occurrence of mating, mounting or presenting in the chacma baboons of South Africa over a period of three and a half years.

However, one cannot rule out the possibility of mating by the baboons either late in the evening or even in the night during which times our observations did not cover. This suggestion seems justified by the report of Stoltz and Saayman (1970) who sometimes heard during the night, the "typical staccato calls" given by female chacma baboons when they copulate.

It is interesting that we collected a lot of baboon faecal droppings without any direct observation of the animals defaecating or urinating. Perhaps the animals chose to perform these acts under cover of vegetation or it might be that we were simply not opportuned to catch them while performing the acts. Hall (1963b) has reported that defaecation in baboons is a common alarm-reaction readily elicited by threat-attacks. The absence of the latter in our baboon troops probably explains our lack of seeing the former in them. This inference is based on Hall's observation cited above.

We did not observe the baboons perform other activities like biting, ignoring, greeting or wailing, the last of which Marais (1939) associates with the mourning of their dead by the animals.

6-5 SLEEPING

The KLNP baboons showed not the least inclination for nocturnal life. Day-light determined when they would descend from the sleeping trees to start foraging for the day and it also determined when the animals would retire for the night. The time of descent and ascent of sleeping tree-complex by the baboons has been dealt with in relation to the range of the animals in both usual and longer photoperiods.

Baboons sleep on tree-branches in a sitting position as indicated by the few of them which were not completely concealed by foliage. Sleeping time could not be exactly determined. It is however assumed that sleeping commences as soon as the baboons retire for the night around 18.30 hours and lasts until the daylight the following day, usually around 6.00 - 7.00 hours.

Baboons are habitual animals. They use traditional routes, drinking places and food items. The same behaviour is extended to their use of sleeping trees. Only tree

complexes were used and even these were a few species like Diospyros mespiliformes, Isoberlinia tomentosa, Ostryoderris stuhlmannii, and Afzelia africana. All the plants utilised as sleeping trees are well-foliated. This helped to conceal the animals as soon as they settle on them for the night. In addition, no large-sized trees were used. This removed the possible difficulty which the juveniles would certainly have encountered in climbing and descending such trees.

Each troop utilised four to five sleeping tree-complexes, a complex being a collection of two or three adjacent trees. The complexes were irregularly used. Lumsden's (1951) report shows a similar number of sleeping trees and the irregularity of their use by Ugandan olive baboons. The consistent though irregular use of a few sleeping trees strictly selected indicates that the baboons have fixed habits. Thus for example, they hardly explore the possibility of utilising new sleeping trees which had not been traditionally established to be safe. This explains why Buxton (1951) found out that some Ugandan olive baboon groups were still using the same set of sleeping trees after nearly two and a half years of initial observations by Lumsden (1951).

It seems that the baboons use only those sleeping trees that could guarantee their overnight rest which they usually pass in silence except when intruders disturb them. As earlier mentioned lions were invariably the culprits of such intrusions although other factors not known to us might also possibly be involved.

CHAPTER 7

BABOONS AND OTHER ANIMALS

CHAPTER 7

B A B O O N S A N D O T H E R A N I M A L S

7-1 PREAMBLE

Mention has earlier been made of the fact that check-lists of animals in the study area have been compiled by both TDC (1972) and Child (1974). Many of the listed animals were sighted by us but this chapter will deal with only those animals that the baboons interacted with. Such animals are either "Predators" or "Non-Predators" and will be treated as such in the discussion which follows.

7-2 PREDATORS

The potential predators of baboons apart from man are lions, leopards and hyaenas. Others are the python (Marais, 1939; Stoltz and Saayman, 1970), black eagle Aquila verreauxi (Hall, 1963a), martial eagle (Rowell, 1972) and chimpanzee (v.Goodall, 1971). The last two, and perhaps the black eagle also, are known to prey on immature baboons alone.

Lions and hyaenas were sighted in the field but not leopards which reliable reports indicate are present in the Park. Only lions and man were observed to interact with the baboons and discussion on baboon predators will be limited to them.

7-2.1 Man

The chief predator of the Nigerian baboon is man. Man hunts the baboon for its flesh and as a means of trying to control its crop-raiding menace by reducing its number. The average Nigerian farmer is delighted to watch baboons in the menagerie but not in the wild where he would rather have them killed in order to protect his crops.

During the six-month period of this study, man was responsible for killing at least 33 baboons inside or close to the KLNP. The main target of the poachers are the bulky adult males which should fetch relatively more money for their flesh than any other class of the animals. A market survey conducted by Abolude and Otegbade (1976) shows that a kilogramme of baboon flesh costs one Nigerian Naira and twenty kobo (₦ 1.20 ≏ British £1.00).

Game-keepers and poachers are fighting it out in the KLNP where the latter continue to hunt the animals of the

Park for commercial purposes. Unfortunately, the better-armed poachers seem to be winning just as they are reported by Ronay (1978) to be doing in Russia. One reason for the success of the poachers is that hunting is more lucrative than farming around the KLNP (Ayeni, 1977b). Secondly, apart from being ineffectively armed, the game-scouts do not undertake consistent patrol of the Park which in fact seems too large for their numerically small force. A third factor that tends to weaken the cause of the anti-poaching campaign is that the law-courts appear to be lenient on arrested poachers and trophy dealers. The fines and/or sentences imposed on the latter are, to say the least, meagre. This situation encourages habitual poaching by convicted poachers as soon as they serve their prison terms or pay their fines. Almost certainly, the only current acute problem of the KLNP Management is posed by the poachers whose wanton activity tells heavily on the populations of nearly all the major animals within and without the Park.

7-2.2 Lions

To witness predation in progress is a rare phenomenon. Thus, for example, Rowell's (1969) study over a period of five years did not record one on baboons. Neither did we see a single case of any form of predation on the baboons in the KLNP.

Lions appear to be the main potential felid predators on the Nigerian baboon and reference has earlier been made to the concurrence of lion roar and baboon alarms on moonlit nights.

Lions probably merely use baboons as buffer species (Bourliere, 1963; Cilliers, 1963) and Saba (1976) has shown that even the large zebra represents a mere buffer prey to them. Dasmann (1964) defines a buffer species as essentially an alternate prey species which serves to decrease predation pressure on another species which by implication is preferred to the buffer species. The KLNP lions usually hunt for the big ungulates, especially roan antelope. This explains why the baboon is not an "efficient prey" (Slobodkin, 1961) for the lions, meaning that it does not seem to make good enough food for them. In fact, Cilliers (1963) has reported that lions will take on baboons only "on occasions of extreme hunger or when the opportunity is too good to be missed".

7-3 HOW BABOONS REACT TO PREDATORS

7-3.1 Reaction to Threat by Man

Baboons run away from man in order to escape being killed. Our observation showed that when baboons fear being molested by man, they do not take to trees but run in

order to make good their escape. Once they realised that man posed a threat, their ultimate safety is to try and outrun him on the ground, including those of them already in the trees. Generally baboons do not stay their ground against human beings although, as this thesis has earlier cited, cases of occasional ferocity towards women and children have been reported.

7-3.2 Reactions to Other Predators

Baboons are known to avoid scattering unnecessarily in an effort to enhance group safety (Crook and Gartlan, 1966). There seems to be security in number particularly in gregariousness (Andrewartha and Birch, 1954; Lack, 1967) and Olaniyan (1975) has stated that experimental evidence shows that an individual is more vulnerable to attack and easier predation than when it is a member of a gregarious group.

However, safety in gregariousness is limited and baboons still have to face the danger of predation by carnivores. This they do by avoidance, alarm and defence, depending on expediency.

Rowell (1969) has stated that baboons cope with danger only by avoidance and never by defence. This sounds an over-simplification, at least as far as leopards are

reported to be concerned. It has been reported by de Ediciones (1970) that in the baboons there is no attempt to stand and fight lions but they might stand up to the leopard. In fact, Marais (1939) observed an adult male baboon attack a leopard to save another adult male and although one of them died, the leopard also was killed. This probably shows why the leopards are reported by Bramblett (1969) to avoid adult males and select juveniles and females instead.

Be that as it may, the first reaction of baboons is to seek safety in trees and then raise alarms as well as bark defiance at felid predators (e.g. Page, 1963). Fortunately for the KLNP baboons, the lions there have never been seen or reported to climb trees. This suggests that they are safe from the latter once they betake to trees.

7-4.1 EFFECT OF POSSIBLE PREDATION ON BABOONS

The effect of predation on prey is still largely topical. One school of thought holds that predators hardly check the number of their prey (e.g. Howard, 1962c) and that, in fact, predation removes especially the young, the old and the sick or unfit animals (Boughey, 1973). This leaves the reproductives relatively free from predation. On the other hand are those (e.g. Debach, 1974) who assert that

biological control by natural enemies could be effective in checking prey or host numbers and that predation acts in a density-dependent manner.

Whether in general predation effectively limits prey number or not, the baboons of the KLNP are apparently currently not in danger of effective predation by the few lions in the area or the rare leopard there.

7-5 NON-PREDATORS

This category of animals interacting with baboons in the KLNP are the ungulates and the elephants.

7-5.1 Ungulates

The ungulates involved are the kob, Adenota kobus and the warthog Phacochoerus aethiopicus. The baboons were indifferent to the presence of both animals which were at times within five metres of the baboons. Their interactions were certainly neutral. In fact, baboons and ungulates are reported to often drink alongside and that the former usually alert the latter when potential predators appear in such circumstances (Washburn and De Vore, 1961; Page, 1963; de Ediciones, 1970). We had no evidence to contradict or corroborate this observation.

7-5.2 Elephants

In Kenya, Washburn and De Vore (1961) observed that baboons and elephants have a relationship that is neutral rather than co-operative, and that the former merely step out of the way when the latter are approaching. Rowell (1966) reports that baboons and elephants in Uganda share many food plants and so are potential competitors.

Observations during this study indicated that baboons and elephants show an extensive overlap in the utilisation of plant food-items. Virtually all the fruits utilised by the baboons were also utilised by the elephants and both animals were fond of digging up and eating the root tuber of Cochlospermum tinctorum. Such was the degree of their overlapping utilisation of food items that each time the two animals encountered, the baboons would immediately raise a general alarm and run away, while the elephants looked indifferent. We witnessed three such encounters and the reactions from the two animal groups were always the same. It appears that the baboons have learnt to scream and warn one another to run out of the way of an approaching herd of elephants.

It would have been interesting to have the opportunity of seeing what might possibly happen if a baboon troop stayed

its ground against an approaching herd of elephant. Such an incident should indicate why the baboons have come to fear and avoid the elephants in the KLNP.

CHAPTER 8

BABOON MANAGEMENT

CHAPTER 8

B A B O O N M A N A G E M E N T

8-1 MANAGING THE BABOONS INSIDE THE KLNP

8-1.1 Introduction

Effective management of a Nature Park is a complicated matter. It is not the intention of the writer to go into an overall management proposal for the KLNP. Rather, this part of the report will concentrate on how the baboons could best be managed there, although other animals would necessarily derive benefits therefrom.

The major objects of baboon management are to preserve the balance between baboons and the totality of the KLNP environment, and to control possible crop-raiding around the Park by the animals.

One of the most basic approaches in managing animal populations is through habitat management. This end could be achieved by the preservation of, or if necessary manipulation to obtain, a suitable habitat. The KLNP can be managed in

relation to the nearly 6,000 baboons by providing the animals with adequate water-holes during the dry season. The way in which this can be done and the ecological implications of the suggestion will come under the next sections.

8-1.2 Provision of Water-holes in the Dry Season

All permanent water-holes in the Park should be known and kept under surveillance. Since these are generally in limited supply during the dry season, it is recommended that the Management undertake a limited amount of digging to open up and clear water-holes then. There should be, if and when necessary, addition of artificial water-holes and mineral licks to those that are available.

Artificial water-holes can be provided through mechanical excavation of ponds on suitable sites. The construction of such ponds should be based on the rainy season dispersion of the baboons so that the animals might easily locate and utilise them.

The maintenance and provision of dry-season water-holes will be useful to the baboons and water-bound animals such as the kobs, Adenota kobus. The measure will ensure that the animals have enough water to utilise during the critical dry period. It will prevent overcrowding of the animals along the Oli River banks at such periods. This will

decrease the incidence of poaching on baboons along the Oli River where poachers realise that most animal species in the Park concentrate in the dry season. In addition to being useful to the baboons and other animals, such water-holes should be of immense value to the Management in case it is faced with a problem of fire-fighting in the Park.

8-1.2.1 Ecological Implications of Providing Water-holes

The provision of artificial water-holes in the dry season needs caution in view of the possible ecological implications of the proposal.

One such implication is that all animals benefitting from the project are likely to increase in number. This may result in a pressure which the habitat might find impossible to stand. Another ecological implication of providing artificial water-holes is that many species of animals might disperse to places they are not used to under natural conditions. This may adversely affect their behaviour and safety from predators and other environmental hazards.

Therefore the execution of the above recommendation requires more knowledge of the ecosystem of the Park. It might even be done on experimental basis in which a restricted

area of the habitat is used for pilot trial. If this succeeds, the project could then be cautiously introduced into the whole Park.

8-1.3 Suppression of Poaching

Apart from improving the habitat for the benefit of the animals, the Management should drastically reduce illegal hunting by means of an efficient patrolling system including an adequately trained ranger force which must be effectively armed. This is to protect and conserve not only the baboons, but all other major animals in the Park. If anti-poaching activities are to be worth their while, they must be efficiently done. The present system whereby patrols are haphazard due to shortage of vehicles and a small force of poorly-armed game-guards seems inadequate. It must be replaced by one in which the anti-poaching force is expanded, well-equipped especially in terms of arms, and is always on the alert both within and without the Park.

The raising of an efficient ranger-force should be supplemented with one or two proposals. The first of these is the employment of a few paid informants. Unlike the regular ranger force these are not to be uniformed and should be recruited from amongst the natives with whom they normally

live. There is no doubt whatsoever that such paid informants will justify whatever pay, even if meagre, they receive. The second proposal, which is not a novel idea, is to seek the active co-operation of the local chiefs in checking their subjects who engage in poaching. The local chiefs are likely to do what prosecution, public education and enlightenment seem incapable of doing. Fortunately enough, the local chiefs are usually understanding and co-operative. Appeals through them should therefore be renewed and intensified in an attempt to control poachers.

Thus, a combination of an efficient patrolling system, paid informants and intensified appeals through local chiefs should curb the menace of poaching, the problem number one of the KLNP Management.

8-1.4 Caring for the Health of the Animals

Baboons should be examined from time to time from the point of view of physical condition as a way of monitoring the animals in relation to habitat. Prolonged emaciation of the animals might necessitate the improvement of the habitat and/or the culling of the animals in order to avert disaster to both the animals and the habitat.

In addition, the remains of dead baboons should be pathologically examined to determine the causes of their death. Remedial or preventive health measures should then be taken in respect of living animals in the Park.

The above measures should keep the baboon stock healthy.

8-1.5 Culling to Control Animal Number

The improvement of the habitat during the dry period, an efficient anti-poaching system and health attention on the baboons along the suggested lines should, all other things being equal, lead to an increased density of the animals in the Park. The culling of the animals may then become necessary.

Culling is usually done when particular animals become too many and may threaten the habitat by over-use or when they exhibit marked declines in condition or health. The exercise leaves a viable stock. A sensible culling exercise must take the structure and social organisation if any, of the animals that are due for cropping. For this reason, killing must be on a selective basis with due consideration for age and sex.

In the case of the baboons, culling should remove the animals in such a way that it leaves behind the dominant adult male of the troop. Otherwise, it might temporarily upset the troop structure and behaviour. The exercise should also leave behind about two adult females to every adult male. Advisedly, the ratio of one old to one young animal should not be disrupted by the cropping exercise. In the alternative, attempts might be made to kill off selected whole troops to avoid excessive shyness due to shooting.

Apart from checking the over-use of the habitat by a particular species, culling will fetch money for the Park Management. Bush-meat is generally regarded as a delicacy by Nigerians who also make various uses of the trophies obtained from the animals. Such other uses are generally for medicine and for ornamental decorations (Abolude and Otegbade, 1976).

8-2 CONTROL OF CROP-RAIDING BY BABOONS

8-2.1 Introduction

Man cannot hope to avoid his pests because as part of nature he is bound to come into conflict with other organisms in his environment. In this respect, man is not unique: all

other animals also have numerous species that are pests to them. The aim of control is to remove or at least minimise the undesirable consequences of man's necessity for land-use. Control does not mean to exterminate the pest or even to attempt doing so. It is even doubtful if man could completely eliminate his many pests, but all attempts to alleviate their effects seem desirable, particularly vertebrate pests whose control is "a disorganised and largely neglected field of science" (Howard, 1962c).

Although it was one of the aims of this study to make recommendations for checking crop-raiding by baboons, we did not observe a single instance. No baboon troops were seen in cultivated areas around the Park. An alleged raid by baboons of a poacher's farm proved false on investigation. Another allegation from a village near the Park was most probably true as the farm was within reach of a baboon troop not under our direct observation. Reliable reports of crop raids by baboons in Shaki area (also in the Guinea Savanna Zone) were received and such raids are even said to be an almost annual event (Adedeji, pers. comm.).

It is in the light of these reliable allegations and reports of crop-raiding by the Nigerian baboon that the preliminary ecological facts emerging from this study are

considered relevant in making recommendations for preventing or at least minimising the menace.

The mass killing of pests to reduce their numbers to a tolerable level is a common control measure (e.g. Lindner et al, 1963). When he engages in this activity man essentially becomes a predator. Howard (1962c) has stated, inter alia, that "as far as most vertebrate pest problems are concerned, predators seldom provide significant help if any at all, in resolving most of the problems". This opinion has been corroborated by Omar and de Vos (1970) who report that the killing of sykes monkeys actually increased damage caused by them.

In fact, one popular concept earlier mentioned about predator-prey relationships is that the predators, by killing off mostly the aged and the sick among their preys may stimulate density increase of the preys instead of limiting it (e.g. Boughey, 1973).

8-2.2 Control Recommendations

Preliminary facts obtained from this study indicate that crop-raiding by baboons can be minimised in the following ways:

8-2.2.1 Farm Sites Must be Carefully Selected

The Nigerian baboon troop is fond of ranging within savanna areas containing water, tree clusters and rocky outcrops. It tends to forage using traditionally established routes and does no more than 6.4 kilometres (4.0 miles) in a day from its overnight sleeping site of tree clusters (or near rock outcrops in Yankari, Nigeria, as implied by the FAO Wildlife Consultant, 1975). Any farm sited some seven or more kilometres from such areas or routes favoured by baboons is likely to be outside their reach.

Where it is not practicable to select a farm site remote enough from a possible baboon haven, it is recommended that the farm should be located near a road or an open area through which people usually pass. Baboons seem to be reluctant to cross roads and open places where they become exposed. The farmer could therefore capitalise on this aspect of baboon behaviour in order to protect his farm. The more exposed a farm, the higher its chances of being not raided by baboons. Conversely, a farm located very close to thicket and bush cover provides an ideal condition for crop-raiding.

8-2.2.2 Bigger Farm Sizes

Ridpath and Meldrum (1968b) have shown that large paddocks suffer little if any damage in the middle when the pestiferous hens raid them, whereas damage to small paddocks is almost entire. Maples (1969) has reported also that damage to small crop fields is often common. These observations suggest that a large farm, by virtue of its size, is more conspicuous than a small one and certainly requires more time to raid.

Since baboons prowl to raid, large farms expose them more than small ones and may therefore keep them at bay for fear of being detected. However, a large farm size suffers one disadvantage:the vigil over it has to involve many people to have any significant effect.

8-2.2.3 Separation of Baboons from Target Crops through Cultural Manoeuvres

Cultural practices like crop rotation, shifting cultivation and mixed cropping are all measures that tend to separate the pest from its host - for some time though. Such control measures have been applied on insect pests. Just as the decline of susceptible hosts will make the

pestiferous habit of the bark beetle to decline (Balogun, 1965) it is submitted that the above-named cultural practices by shifting farm positions and crop types may serve to confuse the baboons. This would delay their raids. Similarly, mixed cropping with some tuber plants involved will not only delay a raiding party but will also save most of the tubers.

By not making target crops easily available the farmer might discourage the intention of the baboons to raid his crops. Crop-raiding baboons would almost certainly be in a hurry and might therefore be deterred by the farmer's cultural delay tactics.

8-2.2.4 Farm-fencing Using Spiny Plants

Although laborious, farm-fencing is a worthwhile practice by many peasant farmers who use spiny plants like Euphorbia kamerunica and Opuntia spp. Baboons are known to eat the prickly pear, Opuntia (Crook and Aldrich-Blake, 1968). The hope of using spiny plants therefore lies only the delay which they will certainly cause a raiding party. Such delay may make a difference as to whether a farm is saved or not.

Obviously, farm-fencing could be limited by farm size but where it is possible to do it using spiny .

plants, the continuation or introduction of its use is very much recommended.

8-2.2.5 Effective Human Attendance on the Farm

Baboons fear man and Maples (1969) has earlier been quoted as reporting that the mere presence of human beings is usually sufficient to restrain them from inflicting any serious damage on farms.

The baboons are capable of playing hide and seek in order to successfully raid a target farm under human observation. For this reason, it is suggested that the number of observers keeping watch over a farm should be commensurate with the size of the farm. Also, in view of the fact that baboons are daring enough to frighten women (e.g. Skoda, 1974) and to attack children (e.g. Nash, 1976) it is recommended that at least one man should be involved in keeping watch over a farm, whatever its extent. In addition, a small firearm should be kept handy as baboons are reported to distinguish an armed man from an unarmed one (Clarke, 1969).

Although Maples (1969) discovered that the Kenyan crop-raiding baboons confine their menace to mid-morning and

mid-afternoon, it is recommended that human vigilance on farms commence from dawn till dusk in order to cover the entire foraging period of the animals. For this purpose, the Nigerian peasant farmers' common habit of erecting small huts on farm sites should be encouraged as this keeps them on their farms during the day-time.

8-2.2.6 Killing of Baboons

The five fore-going control recommendations are preventive measures against crop-raiding by baboons. It is believed that they should prove effective in checking the menace of crop-raids by baboons.

However, should the preventive measures fail to deter any adventurous baboon groups, the farmer is faced with only one choice - to kill the animals. This end could be achieved by shooting, poisoning and trapping on a very large scale, otherwise it might not succeed. In fact, Caughley (1977) has reported that most control attempts to destroy an animal population have been unsuccessful when they are aimed directly at the animals themselves instead of through changing the habitat.

CHAPTER 9

SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

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9-1 SUMMARY AND CONCLUSIONS

This report is based on a field study of the population ecology of the Nigerian savanna olive baboon, Papio anubis Fischer. Population ecology as defined here means the population structure of the animal in relation to the habitat and the utilisation of the habitat by the animals.

The olive baboon is a medium-sized monkey commonly found in West and East Africa. The study area is the Kainji Lake National Park of Nigeria, otherwise referred to as the KLNP or simply, the Park. It lies within the Northern Guinea Savanna Zone. Its vegetation falls into five major types as demarcated by Geerling (1976). They are Burkea-Terminalia avicennioides Savanna Woodland, Acacia complex, Detarium Savanna Woodland, Afzelia Savanna Woodland and Isoberlinia tomentosa Woodland. The area is characterised

by annual bush burning and a wide distribution of low and tall termite mounds.

The study collected data on the population structure, dispersion, ranging and feeding habits, and on other aspects of baboon ecology in the KLNP. The basic methodology of study was observational and the observations were organised on stratified random sampling of the habitat. The findings reported here on the Nigerian olive baboon are preliminary and the conclusions drawn therefrom should be treated, at least in many cases, as tentative.

Realising that baboons like other animals are difficult to count accurately in the wild, all possible precautions were taken to obtain dependable census figures.

We encountered 32 baboon troops in 37 sampling units out of a total of 200. The 32 troops did not show any significant preference for any of the five habitat types listed earlier. Troop size ranged from 18 to 43 animals. The troop mean size varied within and from habitat to habitat in the Park. The overall weighted troop mean size was 33 animals (33.15 ± 2.07).

Data analysis revealed that the KLNP baboons attained significantly larger troop sizes in areas with permanent source of water than they did in areas which lacked it. Similarly, the density of the baboons was significantly higher in areas of the Park characterised by availability of permanent water than those without such water.

The overall baboon density in the Park was 23 animals (23.22 ± 1.78) per 20 sq. km.

Nine troops consisting of 248 baboons were thoroughly enumerated. The result shows that the adult females outnumber adult males in a ratio of 2 : 1. Immatures and mature baboons exist in almost the same proportions and this fact indicates a more or less stable population of the KLNP baboons. The ratio of adult females to immature baboons is 1 : 1.5. The future determinations of this ratio should, according to Rowell (1972), indicate the trend of population growth of the baboons with time.

The total baboon population in the KLNP as computed from this study is of the order of 5,734 animals.

The baboons foraged daily for food. Full adult males were observed to lead the direction of day-range on most days. The larger the troop size, the longer the daily distance the troop covered. All the four troops under detailed observation covered longer distances in the wet than in the dry period although within the limitation of the day-range data the difference is statistically insignificant ($\chi^2 = 0.034$; $P > 0.05$; d.f. = 3).

Three out of the four baboon groups kept under detailed observation showed a moderate negative correlation between temperature and day-range distance (- 0.52, - 0.55 and - 0.69). Thus, the hotter it was, the shorter the distance the troops ranged. We observed that heavy rain immobilised the baboons except where the tree canopy was thick enough to give shelter.

There was a high positive correlation between troop size and the extent of home-range (correlation coefficient, r, = 0.97). This means that the larger the troop size the larger will be its home area. It is postulated that the tendency of the baboon groups to scream and run away from approaching elephant herds may possibly have some effect on the pattern of utilisation by the baboons of their

home areas. The situation may even possibly eventually limit the size of the home areas of baboons. It was not possible to quantify any other factor that may conceivably affect the extent of the home-ranges of the KLNP baboons. However, the widespread availability of water in the rainy period was observed to lead to the utilisation of previously unused portions of the home areas of the animals.

Data on the feeding ecology of the KLNP baboons show that the animals are highly selective of what they eat. They were observed to utilise only 19 floral species in a way that was quite unrelated to the distribution and availability of major plant species in the habitat. The animals are mainly frugivorous and were even eating dry pods of Tamarindus indica with relish. Underground storage tubers were extensively used in the dry period usually characterised by scarcity of food and water. We did not see the animals utilise any leaf blades.

The baboons fed mainly on the ground level where they hand-picked most of their food items. In spite of this, their floral diets overlapped with the elephants'.

As revealed by faecal examination, termites and to a lesser extent beetles, constituted the major source of animal protein for the baboons. Because it was easy to separate adult faecal droppings from those of immatures on the basis of their relative sizes, the results of faecal examination show that adults utilised termites and beetles much more than the juveniles did. There is no reason to suppose that the results could have been influenced by a more efficient digestion of insect remains by the immature baboons.

We did not witness a single instance of game-hunting or meat-eating by the baboons.

Other aspects of their feeding behaviour include frequent use of water and perhaps mineral licking. The use of mineral licks by the Nigerian baboon has been reported by Henshaw and Ayeni (1971) and Ayeni (1972).

A total of 36,750 scanning observations were made on the baboons for a quantitative record of their routine activities. These observations have been called individual activity records, IAR's (Crook and Aldrich-Blake, 1968). The records show that the baboons that were observed spent

47 per cent of their time feeding, approximately 20 per cent on resting and nearly 12 per cent drinking water. Other activities performed to much lesser degrees included barking, grooming and quarrelling. No single instance of copulation was observed throughout the six months of investigation.

There was diurnal variation in all recorded activities. Expediency seemed to dictate the most suitable day-time period for the animals to perform a particular activity. Thus, for example, feeding was most intense in the morning and least so in the late afternoon while quarrelling among juveniles was virtually non-existent in the morning period and maximal in the late afternoon after extensive feeding.

Group screaming on moonlit nights suggests that the baboons were vigilant even when they were supposed to be sleeping. This behaviour was almost certainly directed at lions on the prowl.

The conclusion is drawn that man is the chief enemy of the KLNP baboons. He uses them as a source of animal protein and to a lesser extent for medicinal purposes. The few lions in the KLNP are not a serious threat, if at all, to the baboons in the area. The latter are probably

a mere buffer species to the former. Some ungulates and baboons showed a neutral relationship: we did not observe meetings between baboons and many other species of ungulates.

There was an extensive overlap in floral dietetic items that were being utilised by baboons and elephants. This suggests the existence of a potential competition for food resources between the two species and may account for avoiding action by baboons on the approach of elephants.

The observations and conclusions reported here on the population ecology of the baboons as defined by this study have an important bearing on the active management of the animals both within and without the Park.

This work has pointed out the impact of water on baboon ecology. For this reason it calls for the maintenance, and if necessary provision, of water-holes for the animals during the dry period. Dry season limitation of water distribution may expose the baboons to predation and poaching pressure along the banks of Oli River where they look for water at such times. Attention is however drawn to possible ecological implications of the proposal and caution is called for in its execution.

There is an urgent need for more active measures to suppress poaching activities within and around the Park. Towards this and, it is recommended that the efficiency of the ranger force should be raised, that paid informants be employed amongst natives living around the Park and that renewed appeals be made to poachers through influential local chiefs.

It is suggested that the KLNP Management encourage research on checking the condition of the baboons from time to time as a way of monitoring the animals in relation to the habitat. The results of such research might save the animals and/or the habitat from degradation. Dead and/or sick baboons should be examined to determine possible causes of death and diseases that might afflict the animals. This measure should ensure the maintenance of a healthy stock of baboons in the KLNP.

It is realised that the improvement of the habitat as suggested here, effective suppression of poaching and active research on the condition of the baboons, are measures that would almost certainly lead to a substantial increase in the population of the animals. This situation might

give rise to an undesirable spread of the baboons in the Park to cultivated areas nearby. The consequence of this might be crop raiding by the animals. To avert such situation the animals should be cropped as this becomes necessary.

If the baboon populations have to be controlled by means of culling, it is desirable to try not to upset the balance in sex and age ratios. Culling exercises should leave the troops with the ratios of two adult females to one adult male - preferrably a full adult male - and one old to one immature baboon. Alternatively, whole troops could be killed off in order to avoid excessive shyness and other undesirable behavioral changes which selective shooting may have on the remaining animals of a troop.

The Nigerian olive baboon, like other baboon populations in Africa, is a notorious crop-raider. However, there was no authentic case of crop-raiding by the baboon groups under our observation. Be that as it may, it is necessary to protect nearby farmlands from possible marauding by the KLNP baboons. The recommendations apply to farmers in all areas where baboon populations occur.

The gist of these recommendations is careful selection of farm-sites away from locations favoured or frequented by baboons and, what is probably more important, an effective human attendance on farms. The author reluctantly calls for indiscriminate killing of baboons on cultivated lands only as a last resort and even doubts whether this measure can achieve the desired goal of checking crop-raiding by baboons. Habitat management along the lines suggested would almost certainly be more effective.

9-2 SUGGESTIONS FOR FURTHER RESEARCH

There are three main lines of research that follow on from the work reported here. These are:

1. determining the relationship between baboons and other species notably the elephants and the extent to which they are in competition with elephants.

2. In the event of it being necessary to reduce the number of baboons in the Park or to manipulate the population in any way, it will be necessary to know more about the social organisation of the animals. In particular answers should be sought to the following questions: what is the effect upon the troop of reduction in its number

say by one-half and the loss of key members of the troop? How does the troop then reorganise itself and how soon does it regain its former size? Is the course of reorganisation different in the better as opposed to the poorer habitat? The clues can be discovered by monitoring a given troop before and after the culling operation.

3. Outside the Park, it will be desirable to test the ideas suggested here on the control of crop-breeding by habitat management on farm-lands.

LITERATURE CITED

L I T E R A T U R E C I T E D

ABOLUDE, F.A. and OTEGBADE, J.O. (1976). Summary of Pattern of Utilisation of Wildlife Species in Nigeria. Wildlife Progress Report: Federal Dept. of Forestry, Nigeria, Unpublished Typescript.

ADEDEJI, A. Pers. comm.

AFOLAYAN, T.A. (1976a). Habitat Utilisation by Elephant in the Guinea Zone. Comm. For. Rev. 55(1): 65 - 71.

AFOLAYAN, T.A. (1976b). Methods of Assessing the Effects of Burning and Grazing on Different Vegetation Communities in Savanna Woodland. Wildlife Management in Savanna Woodland: Proc. of the Ibadan/Garoua Int. Symp. on Wildl. Mgmt.: 233-247 (Eds. Ajayi, S.S., Geerling, C., Van Lavieren, L.P., and Hall, J.B.).

ALDRICH-BLAKE, F.P.G., BUNN, T.K., DUNBAR, R.I.M. and HEADLEY, P.M. (1971). Observations on Baboons, Papio Anubis, in an Arid Region in Ethiopia. Folia Primatol 15; 1-35.

ALLEN, W.E. (1929). The Problem of Significant Variables in Natural Environments. Ecology Vol. X (No. 2): 223-227.

ALTMANN, S.A. (1974). Baboons, Space, Time and Energy. Amer. Zool., 14: 221-248.

ALTMANN, S.A. and ALTMANN, J. (1970). Baboon Ecology, African Field Research. The University of Chicago, Chicago and London.

ANDREWARTHA, H.G. (1970). Introduction to the Study of Animal Populations. English Language Book Society and Chapman & Hall, London.

ANDREWARTHA, H.G. and BIRCH, L.C. (1954). The Distribution and Abundance of Animals. Univ. of Chicago Press: Chicago.

ASTLEY MABERLEY, C.T. (1963). The Game Animals of Southern Africa. Nelson, Johannesburg.

AYENI, J.S.O. (1972). Notes Taken from a Hide Overlooking a Lick at Yankari Game Reserve, North Eastern State of Nigeria. J. West Afr. Sci. Ass. 17(2): 101-112.

AYENI, J.S.O. (1977a). Management Problems of the Kainji Lake National Game Park, Nigeria. (In press).

AYENI, J.S.O. (1977b). Attitudes to Utilization and Management of Wildlife in Rural Areas. Invited paper presented at the 7th annual conference of Forestry Association of Nigeria in Kano. 1st to 7th May, 1977 (17 pages).

BAILEY, N.T.J. (1964). Statistical Methods in Biology, Unibooks: Hodder and Stoughton, London.

BALOGUN, R.A. (1965). Studies on the Nutrition of the Ips cembrae (Heer), (Coleoptera:Scolytidae), Ph.D. Thesis, University of Edinburgh.

BERE, R.M. (1962). The Wild Mammals of Uganda. E.Afr.Nat. History Series.

BERNHARD and GRXIMEK, M. (1960). Serengeti Shall Not Die. Fontana/Collins.

BOUGHEY, A.S. (1973). Ecology of Populations. MacMillan: New York.

BOURLIERE, F. (1963). Specific Feeding Habits of African Carnivores. African Wildlife 17 (1); 21-28.

BOURLIERE, F. and HADLEY, M. (1970). The Ecology of Tropical Savannas. Annual Review of Ecology and Systematics Vol. 1 : 125-152.

BRAMBLETT, C.A. (1969). Non-Metric Skeletal Age Changes in the Darajani Baboon. Amer. J. Phys. Anthrop. 30 (New Series): 161-172.

BROWN, D. (1967). Borgu Game Reserve: A Survey. Unpublished MS. Kwara State Forestry Dept., Ilorin.

BUETTNER-JANUSCH, J. (1965). Biochemical Genetics of Baboons in Relation to Population Structure. The Baboon in Medical Research, pp. 95-110. Ed. Vagtborg.

BUXTON, A.P. (1951). Further Observations of the Night-Resting Habits of Monkeys in a Small Area on the Edge of the Semliki Forest, Uganda. J. Anim. Ecol. 20(1): 31-32.

CARO, T.M. (1976). Observations on the Ranging Behaviour and Daily Activity of Lone Silverback Mountain Gorillas (Gorilla gorilla beringei). Animal Behav. 24: 889-897.

CAUGHLEY, G. (1977). Analysis of Vertebrate Populations. Wiley, London.

CAUGHLEY, G. and GODDARD, J. (1972). Improving the Estimates from Inaccurate Censuses. J. Wildl. Management 36(1): 135-140.

CHARTER, J.R. (1970). Vegetation Ecological Zones. Unpublished MS. Federal Dept. of Forest Research, Ibadan.

CHILD, G.S. (1974). An Ecological Survey of the Borgu Game Reserve. Kainji Lake Research Project, Nigeria. F.A.O. (FI : SF/NIR 24, Technical Report 4), Rome.

CHIPPERFIELD, J. (1975). My Wild Life. Pan/MacMillan, London.

CILLIERS, W. (1963). Lions Apparently Do Eat Baboons. African Wild Life 17(1) : 17-18.

CLARK, L.R., GEIRER, P.W., HUGHES, R.D. and MORRIS, R.F. (1967). The Ecology of Insect Populations in Theory and Practice. Methuen & Science Paperbacks. London.

CLARKE, J. (1969). Man is the Prey. Panther, London.

CLAYTON, W.D. (1958). Secondary Vegetation and the Transition to Savanna near Ibadan, Nigeria. J. Ecol. 46(2): 217-238.

CLUTTON-BROCK, T.H. (1977a). Some Aspects of Intraspecific Variation in Feeding and Ranging Behaviour in Primates. Primate Ecology, Pp. 539-556 (Ed. Clutton-Brock, T.H.).

CLUTTON-BROCK, T.H. (1977b). Appendix 1: Methodology and Measurement. Primate Ecology: (Appendix 1) 585-590. (Ed. Clutton-Brock, T.H.).

CLUTTON-BROCK, T.H. and HARVEY, P.H. (1977a). Species Difference in Feeding and Ranging Behaviour in Primates. Primate Ecology: 557-584. (Ed. Clutton-Brock, T.H.).

CLUTTON-BROCK, T.H. and HARVEY, P.H. (1977b). Primate Ecology and Social Organisation. J. Zool, London, Vol.183 (Part 1): 1-39. (Proceedings of the Zoological Society of London).

COLLIER, F.S. (1953). Yoruba Hunters' Salutes. Nigerian Field XVIII (2): 52-67.

COOPER, C.F. (1961). The Ecology of Fire. Sci. American 204(4): 150-160.

COTT, H.B. (1968). Nile Crocodile Faces Extinction in Uganda. Oryx: Journal of the Faunal Preservation Society, Sept. 1968, Pp. 330-332.

CROOK, J.H. (1970). The Socio-Ecology of Primates. In: Social Behaviour of Birds and Mammals. Pp. 103-166. (Ed. Crook, J.H.). Academic Press, London.

CROOK, J.H. and ALDRICH-BLAKE, P. (1968). Ecological and Behavioural Contrasts between Sympatric Ground Dwelling Primates in Ethiopia. Folia Primat. 8: 192-227.

CROOK, J.H. and GARTLAN, J.S. (1966). Evolution of Primate Societies. Nature 210: 1200-1203.

CROOK, J.H. and WARD, P. (1968). The Quelea Problem in Africa. In: The Problems of Birds as Pests: Inst. of Biology Symposia No. 17: 211-229. Edited by Murton, R.K. and Wright, E.N., Academic Press.

DABO, M.M. (Pers. comm.).

DARLING, F.F. (1960). Wildlife Husbandry in Africa. SCI. American 203(5): 123-135.

DASMANN, R.F. (1964). Wildlife Biology. John Wiley & Sons, Inc., New York, London, Sydney.

DASMANN, R.F. and MOSSMANN, A.S. (1962). Road Strip Counts for Estimating Numbers of African Ungulates. J. Wildlife Management 26(1): 101-104.

DEAG, J.M. (1973). Intergroup Encounters in the Wild Barbary Macaque, Macaca sylvanus L. Comparative Ecology and Behaviour of Primates (Ed. by Michael, R.P. and Crook, J.H.), Pp. 315-373. Academic Press, London.

DEBACH, P. (1974). Biological Control by Natural Enemies. Cambridge University Press.

DE EDICIONES, S.S.A. (1970). Baboons: Inheritors of the Earth. (Chapter 5, in World of Wildlife: Africa. Struggle for Survival in the Bush). Orbis Publishing, London.

DE VORE, I. (1963). A Comparison of the Ecology and Behaviour of Monkeys and Apes. Classification and Human Evolution: 301-319. (Ed. Washburn, S.L.) Aldine/Chicago.

DE VORE, I. (1965). Changes in the Population Structure of Nairobi Park Baboons, 1959-1963. The Baboon in Medical Research, Pp. 17-28. (Ed. Vagtborg, H.).

DE VORE, I. and HALL, K.R.L. (1965). Baboon Ecology. Primate Behavior: Field Studies of Monkey and Apes: 20-52. (Ed. De Vore, I.). Holt, Rinehart & Winston: New York.

DE VORE, I. and WASHBURN, S.L. (1963). Baboon Ecology. In: African Ecology and Human Evolution. (Eds. Howell, F.C. and Bourliere, F.). Viking Fund Publications, New York.

DORST, J. and DANDELOT, P. (1970). A Field Guide to the Larger Mammals of Africa. Collins, London.

DUNBAR, R.I.M. (1977). Feeding Ecology of Gelada Baboons: A Preliminary Report. In: Primate Ecology: 251-273. (Ed. Clutton-Brock, T.H.). Academic Press, London.

EATON, G.G. (1976). The Social Order of Japanese Macaques. Scientific American, 235(4): 96-106.

EGUNJOBI, J.K. (1976). An Appraisal of the Savanna Burning Problem. Wildlife Management in Savanna Woodland: Proc. of the Ibadan/Garoua Int. Symp. on Wildl. Mgmt: 264-275. (Eds. Ajayi, S.S., Geerling, C., Van Lavieren, L.P., and Hall, J.B.). Nigeria.

EMLEN, J.M. (1966). The Role of Time and Energy in Food Preference. Am. Natur. 100: 611-617.

EYRE, S.R. (1968). Chapter XVIII, Tropical Savanna: In:Vegetation and Soils;a World Picture. Arnold, 2nd Edition.

F.A.O. (1975). (Wildlife Management Consultant). Nigeria : The Ecology and Management of Yankari Game Reserve. Rome 1975. F.O. DP/NIR/72/002 (Technical Report).

FRISCH, J.E. (1968). Individual Behaviour and Inter-Troop Variability in Japanese Macaques. In:Primates, Pp. 243-252.

GEERLING, C. (1976). Nigeria: Vegetation Map of Borgu Game Reserve (A report prepared for the Kainji Lake Research Project). F.A.O. Rome; FI: DP/NIR/66/524/14.

GILES, R.J. (1969) - Ed. Wildlife Management Techniques (3rd Edition). Wildlife Society: Washington, D.C.

GLOVER, P.E. (1968). The Role of Fire and other Influences on the Savanna Habitat, with suggestions for further research. E. Afr. Wildl. J. Vl: 131-137.

GOODALL, J. (1963). Feeding Behaviour of Wild Chimpanzees: A Preliminary Report. Symp. Zool. Soc. London 10: 39-47.

HALL, K.R.L. (1960). The Social Behaviour of Wild Baboons. The New Scientist, 10th March 1960: 601-603.

HALL, K.R.L. (1961). Feeding Habits of the Chacma Baboons. Advancement of Science 17: 559-567.

HALL, K.R.L. (1962a). Numerical Data, Maintenance Activities and Locomotion in the Wild Chacma Baboon, Papio ursinus. Proc. Zool. Soc. London 139:181-220.

HALL, K.R.L. (1962b). The Sexual, Agnostic and Derived Social Behaviour Patterns of the Wild Chacma Baboon, Papio ursinus. Proc. Zool. Soc. London 139 (Part 2): 2830327.

HALL, K.R.L. (1963a). Variations in the Ecology of Chacma Baboon, Papio ursinus. Symp. Zool. Soc. Lond. 10: 1-28.

HALL, K.R.L. (1963b). Some Problems in the Analysis and Comparison of Monkey and Ape Behaviour. Classification and Human Evolution: Pp. 273-300 (Ed. Washburn). Aldine/Chicago.

HALL, K.R.L. (1965a). Experiment and Quantification in the Study of Baboon Behaviour in its Natural Habitat. The Baboon in Medical Research: Pp. 29-42. (Ed. Vagtborg, H.).

HALL, K.R.L. (1965b). Ecology and Behaviour of Baboons, Patas, and Vervet Monkeys in Uganda. The Baboon in Medical Research: Pp. 43-61. Ed. Vagtborg, Harold.

HALL, K.R.L. (1966). Distribution and Adaptations of Baboons. Symp. Zool. Soc. London 17: 49-73.

HALL, K.R.L. and DE VORE, I. (1965). Baboon Social Behavior. Primate Behavior. Field Studies of Monkeys and Apres: 53-110. (Ed. De Vore, I.). Holt, Rinehart & Winston: New York.

HAMILTON, J., BUSKIRK, R.E., and BUSKIRK, W.H. (1975). Defensive Stoning by Baboons. Nature, 256: 488.

HAMILTON III, W.J., BUSKIRK, R.E. and BUSKIRK, W.H. (1976). Defence of Space and Resources by Chacma (Papio ursinus) Baboon Troops in an African Desert and Swamp. Ecology 57(6): 1264-1272.

HAYNE, D.W. (1949a). An Examination of the Strip Census Method for Estimating Animal Populations. J. Wildl. Mgmt. 13(2): 145-157.

HAYNE, D.W. (1949b). Calculation of the Size of Home Range J. Mammal 30(1): 1-18.

HAYSLETT, M.S. (1967). Statistics Made Simple. (Advisory Ed.P. Murphy). Allen: London.

HENSHAW, J. and AYENI, J. (1971). Some Aspects pf Big-Game Utilisation of Mineral Licks in Yankari Game Reserve, Nigeria. E. Afr. Wildl. J. 9: 73-82.

HESSE, P.R. (1955). A Chemical and Physical Study of the Soils of Termite Mounds in East Africa. J. Ecol. 43: 449-461.

HILL, W.C.O. (1974). Primates. Comparative Anatomy and Taxonomy, Vol. 7.

HIRST, S.M. (1969). Road-Strip Census Techniques for Wild Ungulates in African Woodland. J. Wildl. Mgmt. 33(1): 41-48.

HOPKINS, B. (1963). The Role of Fire in Promoting the Sprouting of some Savanna Species. J.W. Afr. Sci. Ass. 7, 154-162.

HOPKINS, B. (1965). Observations of Savanna Burning in the Oldkemeji Forest Reserve in Nigeria. J. Appl. Ecol. 2: 367-381.

HOPKINS, B. (1974). Forest and Savanna, 2nd Edition Heinemann. Ibadan and London.

-•-and STANFIELD, D. (1966). Savanna Trees of Nigeria. Ibadan.

HOUSTON, D.C. (1974). Report on Hooded Crows and Hill Sheep Farming in Argyll. Unpublished typescript.

HOWARD, W.E. (1962a). 1961 Report of the Wildlife Society's Committee on Economic Losses Caused by Vertebrates. Journal of Forestry, 60(1): 45-46.

HOWARD, W.E. (1962b). Vertebrate Pest Control. Reprint: Proceedings of the Vertebrate Pest Control Conference held at Sacramento, California, February 6-7th, 1962. Pp. 1-7.

HOWARD, W.E. (1962c). Means of Improving the Status of Vertebrate Pest Control. Transactions of the 27th N. Anim. Wildl. & Natural Resources Conf., 1962.

HOWELL, J.H. (1968a). The Borgu Game Reserve of Northern Nigeria. Nigerian Field Vol. XXXIII (3): 99-116.

HOWELL, J.H. (1968b). The Borgu Game Reserve of Northern Nigeria: Part 2. Nigerian Field Vol. XXXIII (4): 147-165.

HOWELL, J.H. (1969). The Borgu Game Reserve of Northern Nigeria: Part 3. Nigerian Field Vol. XXXIV (1): 32-35.

IRVINE, F.R. (1951). West African Botany. Oxford University Press, London.

JEWELL, P.A. (1966). The Concept of Home Range in Mammals. Symp. Zool. Soc. London 18: 85-109.

JOLLY, A. (1972). The Evolution of Primate Behavior. (The MacMillan Series in Anthropology: Eds. Simmons, E.L. and Pilbeam, D.). MacMillan, New York.

JOLLY, C.J. (1963). A Suggested Case of Evolution by Sexual Selection in Primates. Man, Vdl. 63: 177-178.

*JOLLY, C.J. (1964). The Origins and Specialisations of the Long-Faced Cercopithecoidea. Ph.D. Thesis, University of London.

JONES, E.W. (1963). The Forest Outliers in the Guinea Zone of Northern Nigeria. J. Ecol. 51; 415-434.

KEAY, R.W.J. (1959). An Outline of Nigerian Vegetation. 3rd Edition, Federal Min. of Information, Lagos.

KORMONDY, E.J. (1976). Concepts of Ecology. Concepts of Modern Biology Series. Prentice-Hall, New Jersey.

KRUUK, H. (1976). Feeding and Social Behaviour of the Striped Hyaena (Hyaena vulgaris Desmarest). E. Afr. Wildl. J. Vol 14(2): 91-111.

KUMMER, H. (1971). Primate Societies. Group Techniques of Ecological Adaptation. (Ed. Goldschmidt, W.) Aldine/Chicago.

KUMMER, H. and KURT, F. (1965). A Comparison of Social Behavior in Captive and Wild Hamadryas Baboons The Baboon in Medical Research: Pp. 65-80 Ed. Vagtborg, H.

LACK, D. (1967). The Natural Regulation of Animal Numbers. Oxford Univ. Press, London.

LAWICK-GOODALL, J.V. (1971). In the Shadow of Man. Fontana/Collins, Glasgow.

LEEDY, D.L. (1962). A Look at the Future. J. Forestry 60(1): 47-49.

LEWIN, R. (1976). The Rise of Hunting in the Pumphouse Gang New Scientist, 7 Oct. 1976: 26-28.

LINDBURG, D.G. (1977). Feeding Behaviour and Diet of Rhesus Monkeys (Macaca mulatta) in a Siwalik Forest in North India . Primate Ecology Pp. 223-249. Ed. Clutton-Brock, T.H.

* The only reference, a thesis, cited through a third party.

LINDNER, A., BRANDL, M. and WYLER, E. (1963). New Methods to Prevent Game Damage. Translated from German by Forest Service, U.S. Dept. of Agric., Washington, 25, D.C., May 1963.

LOCKIE, J.D. (1959). The Estimation of the Food of Foxes. J. Wildl. Mgmt. 23(2): 224-227.

LOWE, J. and STANFIELD, D.P. (1974). The Flora of Nigeria: Sedges. (Family Cyperaceae). Ibadan University Press.

LUMSDEN, W.H.R. (1951). The Night-Resting Habits of Monkeys in a Small Area on the Edge of the Semliki Forest, Uganda. A Study in relation to the Epidemiology of Sylvan Yellow Fever. J. Anim. Ecol. 20(1): 11-30.

MAPLES, W.R. (1969). Adaptive Behavior of Baboons. Am. J. Phys. Anthrop. 31 (New Series): 107-109.

MAPLES, W.R., MAPLES, M.K. GREENHOOD, W.F. and WALEK, M.L. (1976). Adaptations of Crop-Raiding Baboons in Kenya. Am. J. Phys. Anthrop. 45 (New Series): 309-315.

MARAIS, E.N. (1939). My Friends the Baboons. Anthony Blond.

MARAIS, E.N. (1969). The Soul of the Ape (with the introduction by Robert Ardey). Penguin.

MASON, W.A. (1968). Use of Space by Callicebus Groups. In:Primates (Studies in Adaptation and Variability) Pp. 200-216. Ed. Jay, Phyllis, C.

McNAB, B.K. (1963). Bioenergetics and the Determination of Home Range Size. Amer. Nat. Vol. XCVII (i.e. 97): 133-140.

METEOROLOGICAL OFFICE (1952). Observer's Handbook. Her Majesty's Stationery Office, London.

MILLER, S. (1975). Experimental Design and Statistics. Essential Psychology (Ed. Herriot, P.). Methven.

MILLIGAN, K. (1976). A Preliminary Ecological Management Plan for Lake Kainji National Park. (University of Ibadan) Nigeria.

MOORE, W.G. (1974). A Dictionary of Geography. Penguin.

MORONEY, M.J. (1951). Facts from Figures. Pelican.

NASH, L.T. (1976). Troop Fission in Free-Ranging Baboons in the Gombe Stream National Park, Tanzania. Am. J. Phys. Anthrop. 44: 63-78.

NORTON-GRIFFITHS, M. (1975). Counting Animals. Publication No. 1 in a series of publications on techniques currently used in African Wildlife Ecology. Ed. by Grimsdell, J.J.R. and Russell, H.T. Nairobi.

NYE, P.H. (1955). Some Soil-Forming Processes in the Humid Tropics. IV The Action of the Soil Fauna. J. Soil Sci. 6: 73-83.

OBOLI, H.N.O. and CHURCH HARRISON, R.J. (1965). An Outline Geography of West Africa. George G. Harrap & Co. Ltd.

OGUNWALE, J.A. (1977). Notes on the Rain Forest Weather. Unpublished Ms.

ỌLANIYAN, C.I.O. (1975). An Introduction to West African Animal Ecology. 2nd Edition. Heinemann, London and Ibadan.

OMAR, A. and De VOS, A. (1970). Damage to Exotic Softwoods by Sykes Monkeys. (Cercopithecus mitis kolbi, Neuman) Reprinted from E. Afr. Agric. Ral & Forestry Journal XXXV no. 4. April, 1970.

PACKER, C. (1975). Male Transfer in Olive Baboons. Nature 255; (No. 5505): 219-220.

PACKER, C.R. and COLLINS, A. Pers. comm.

PAGE, E.V. (1963). Lion Calls their Bluff. African Wild Life 17(3): 241-242.

PATTET, A. (1975). Defensive Stoning by Baboons. Nature, 258: 549.

PICKFORD, M. (1975). Defensive Stoning by Baboons. Nature, 258: 549-550.

POLLOCK, J.I. (1977). The Ecology and Sociology of Feeding in Indri indri. Primate Ecology: 37-69. Ed. Clutton-Brock.

POMEROY, D.E. (1976). Some Effects of Mound-Building Termites on Soils in Uganda. J. Soil Sci. 27: 337-394.

POMEROY, D.E. (1977). The Distribution and Abundance of Large Termite Mounds in Uganda. J. Appl. Ecol. 14(2): 465-475.

PRATT, D.J., GREENWAY, P.J., and GWYNNE, M.D. (1966). A Classification of East African Rangeland, with an Appendix on Terminology. J. Appl. Ecol. 3: 369-382.

RATTRAY, J.M. (1960). The Grass Cover of Africa. FAO (Agric. Studies No. 49): Rome.

REICHMANN, W.J. (1961). Use and Abuse of Statistics. Pelican.

RIDPATH, M.G. and MELDRUM, G.K. (1968a). Damage to Pastures by the Tasmanian Native Hen, Tribonyx mortierii. CSIRO Wildl. Res., 13: 11-24.

RIDPATH, M.G. and MELDRUM, G.K. (1968b). Damage to Oat Crops by the Tasmanian Native Hen, Tribonyx mortierii. CSIRO Wildl. Res., 13: 25-43.

RITCHIE, J. (1931). Beasts and Birds as Farm Pests. Oliver and Boyd, Edinburgh.

ROBSON, C. (1973). Experiment, Design and Statistics in Psychology. Penguin Education.

RONAY, G. (1978). Russia's New Civil War. Gamekeepers and Poachers are Fighting it Out. Wildlife (The International Wildl. Magazine): 20(2), 2nd Feb, 1978.

ROSEVEAR, D.R. (1953). Checklist and Atlas of Nigerian Mammals. Govt. Printer, Lagos.

ROTH, W.T. (1965). The Taxonomy of the Baboon and its Position in the order of Primates. The Baboon in Medical Research, Pp. 3-16. (Ed. Vagtborg, H.).

ROWELL, T. (1969). Long-term Changes in a Population of Ugandan Baboons. Folia Primat. 11: 241-254.

ROWELL, T. (1972). Social Behaviour of Monkeys. Penguin: London.

ROWELL, T.E. (1966). Forest-Living Baboons in Uganda. J. Zool. London 149: 344-364.

ROWELL, T.E. (1964). The Habits of Baboons in Uganda. Proc. E. Afr. Acad. 2: 121-127.

SABA, A.R.K. (1976). Predator-Prey Interactions: A Case-Study in the Masai Mara Game Reserves, Kenya. Wildl. Mgmt. in Savanna Woodland: Proceedings of the Ibadan/Garoua International Symposium on Wildl. Mgmt.: 37-52. (Eds. Ajayi, S.S., Geerling, C., Van Lavieren, L.P. and Hall, J.B.). Nigeria.

SCHOENER, T.W. (1971). Theory of Feeding Strageies. Ann. Rev. Ecol. Syst. 2: 369-404.

SCHOENER, T.W. (1974). Resource Partitioning in Ecological Communities. Science 185: No. 4145: 27-39.

SERVICE, M.W. (1965). The Ecology of the Tree-Hole Breeding Mosquitoes in the Northern Guinea Savanna of Nigeria. J. Appl. Ecol. 2: 1-16.

SIMONDS, P.E. (1974). The Social Primates. (Editors: Dethier, V.G. and Zeigler, H.P.) Harper and Row New York, Evanston, San Fransisco, London.

SKODA, CHARLES, P. (1974). Letter to the Editor Biological Anthropology (readings from Scientific America with introductions by Katz, S.H. July 1974): P.89.

SLOBODKIN, L.B. (1961). Growth and Regulation of Animal Numbers. (Biology Studies). Holt, London.

SMITHERS, R.H.N. (1966). The Mammals of Rhodesia, Zambia and Malawi. Collins.

SNEDECOR, G.W. and COCHRAN, W.G. (1967). Statistical Methods. Iowa, U.S.A.

SOLOMON, M.E. (1976). Population Dynamics. Studies in Biology No. 18. Arnold, London.

STANFIELD, D.P. (1970ov). The Flora of Nigeria: Grasses. (Ed. by Stanfield, D.P. and Lowe, J.) Ibadan University Press.

STANFIELD, D.P. (1970b). The Flora of Nigeria: Grasses, Illustrations (Supplement to Grasses) Ibadan University Press.

STEVESON-HAMILTON, J. (1947). Wild Life in South Africa. London.

STOLTZ, L.P. and SAAYMAN, G.S. (1970). Annals of the Transvaal Museum. Vol. 26, Part 5: 99-143. (Annals Transv. Mus. 26(5): 99-143).

STRUM, S.C. (1975). New Insights into Baboon Behaviour: Life with the "Pumphouse Gang". National Geographic 147(5): 572-691.

T.D.C. (NETHERLANDS INST. OF TOURISM DEVELOPMENT CONSULTANTS), 1972. Tourism Study, Kainji Lake Area and Borgu Game Reserve. Vol. 2: Borgu Game Reserve.

THOMAS, D.B. and PRATT, D.J. (1967). Bush-Control Studies in the Drier Areas of Kenya. IV Effects of Controlled Burning on Secondary Thicket in Upland Acacia Woodland. J. Appl. Ecol. 4: 325-335.

UDREY, J.R. and MORRIS, N.M. (1968). Distribution of Coitus in the Menstrual Cycle. Nature 220: 593-596.

VAN EMDEN, H.F. (1974). Pest Control and its Ecology. (Studies in Biology No. 50). Edward Arnold, London.

VAN LAWICK-GOODALL, J. (1971). In the Shadow of Man. Fontana/Collins.

WASER, P. (1975). Monthly Variations in Feeding and Activity Patterns of the Mangabey, Cercocebus albigena (Lydekker). East African Wildlife Journal Vol. 13 Pp. 249-263.

WASER, P. (1977). Feeding, Ranging and Group Size in the Mangabey Cercocebus albigena. In: Primate Ecology (ed. Clutton-Brock): Pp. 183-222.

WASHBURN, S.L. and DE VORE, I. (1961). The Social Life of Baboons. Scientific American 204(6): 62-71.

WATSON, J.P. (1962). The Soil Below a Termite Mound. J. Soil Sci. 13: 46-51.

WATT, K.E.F. (1968). Ecology and Resource Management: A Quantitative Approach. New York.

WIENER, A.S. and MOOR-JANKOWSKI, J. (1969). The A-B-O Blood Groups of Baboons. Am. J. Phys. Anthrop. 30 (New Series): 117-122.

ZUCKERMAN, S. (1932). The Social Life of Monkeys and Apes. Kegan Paul, London.